

(h) Each pilot must be given a rest period upon completion of the HEMES assignment and prior to being assigned any further duty with the certificate holder of—

(1) 12 consecutive hours for an assignment of at least 24 hours but less than 48 hours.

(2) 16 consecutive hours for an assignment of more than 48 hours.

(Sec. 313, 314, and 601 through 610, Federal Aviation Act of 1958 (49 U.S.C. 1354, 1355, and 1421 through 1430); 49 U.S.C. 106(g) (revised, Pub. L. 97-449, January 12, 1983); and 14 CFR 11.45)

**Note.**—This notice proposes regulatory changes that are based on the discussions and recommendations of a regulatory negotiation advisory committee. Since this committee included representatives from the air transportation industry, the FAA believes that these regulatory proposals are not costly. Therefore, the FAA has determined that this notice involves a rulemaking action which: (1) Is not a "major rule" under Executive Order 12291, and (2) is not a "significant rule" under Department of Transportation Regulatory Policies and Procedures (44 FR 11034; February 26, 1979). In addition, it is certified that the proposals, if promulgated, will not have a significant economic impact

on a substantial number of small entities under the criteria of the Regulatory Flexibility Act. A copy of the draft evaluation prepared for this action is contained in the regulatory docket. A copy of it may be obtained by contacting the person identified under the caption "**FOR FURTHER INFORMATION CONTACT.**"

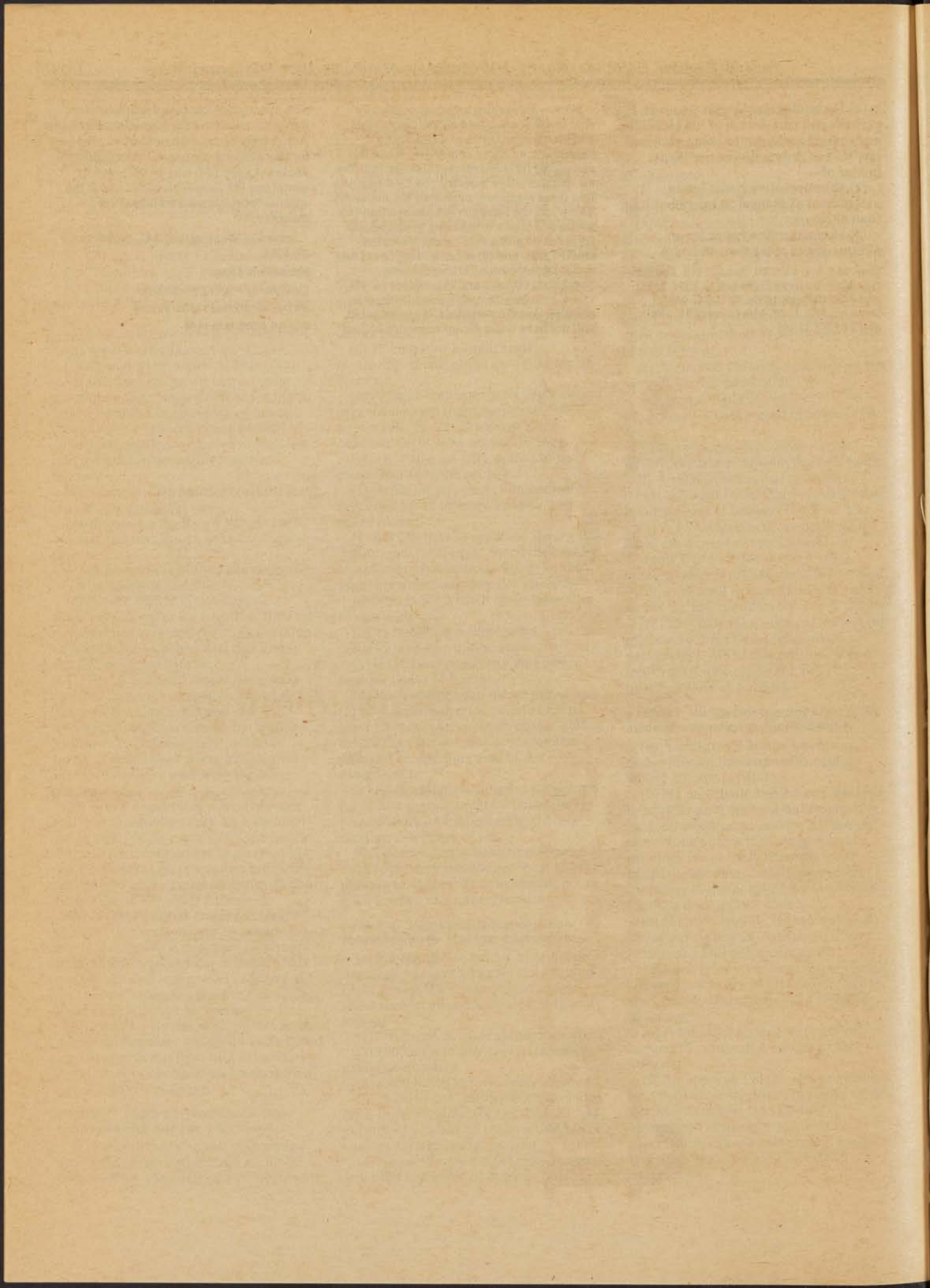
Issued in Washington, D.C., on February 23, 1984.

**Kenneth S. Hunt,**

*Director of Flight Operations.*

[FR Doc. 84-8233 Filed 3-27-84; 8:45 am]

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# **Federal Register**

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**Wednesday  
March 28, 1984**

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## **Part V**

### **Department of Energy**

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**Office of Conservation and Renewable  
Energy**

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**10 CFR Part 430**

**Energy Conservation Program for  
Consumer Products; Test Procedures for  
Furnaces, Vented Home Heating  
Equipment and Unvented Home Heating  
Equipment; Final Rule**



## DEPARTMENT OF ENERGY

Office of Conservation and  
Renewable Energy

## 10 CFR Part 430

[Docket No. CAS-RM-79-104]

Energy Conservation Program for  
Consumer Products; Test Procedures  
for Furnaces, Vented Home Heating  
Equipment, and Unvented Home  
Heating EquipmentAGENCY: Office of Conservation and  
Renewable Energy, DOE.

ACTION: Final rule.

**SUMMARY:** The Department of Energy (DOE) hereby prescribes amendments to its test procedures for furnaces, vented home heating equipment, and unvented home heating equipment. These test procedures are one part of the energy conservation program for consumer products established pursuant to the Energy Policy and Conservation Act as amended by the National Energy Conservation Policy Act. Among other program elements, the legislation requires that standard methods of testing be prescribed for 13 covered products.

DOE is referencing, the American National Standards Institute/American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ANSI/ASHRAE) Standard 103-82 into the furnace test procedure. Other amendments prescribed today for furnaces include test procedures for modulating furnaces and boilers, condensing furnaces and boilers, and thermal stack dampers, and other technical revisions. Amendments prescribed today for vented home heating equipment include test procedures for vented heaters with thermal stack dampers and/or manual controls and a simplified test procedure which covers modulating vented heaters. Amendments prescribed today for unvented home heating equipment include test procedures for unvented heaters that use natural gas, propane, or kerosene. DOE is also including an estimated cost per million Btu output as a measure of energy use for vented and unvented heaters.

EFFECTIVE DATE: (30 days from  
publication)

## FOR FURTHER INFORMATION CONTACT:

Michael J. McCabe, U.S. Department of Energy, Office of Conservation and Renewable Energy, Forrestal Building, Mail Station CE-113.1, 1000 Independence Avenue, SW., Washington, D.C. 20585 (202) 252-9127

Eugene Margolis, Esq., U.S. Department of Energy, Office of General Counsel, Forrestal Building, Mail Station GC-33, 1000 Independence Avenue, SW., Washington, D.C. 20585 (202) 252-9513.

## SUPPLEMENTARY INFORMATION:

## I. BACKGROUND

On October 1, 1977, the Department of Energy (DOE) assumed the authority of the Federal Energy Administration (FEA) for the energy conservation program for consumer products, under Section 301 of the Department of Energy Organization Act (DOE Act) (Pub. L. 95-91). The energy conservation program for consumer products was established by FEA pursuant to Title III, Part B of the Energy Policy and Conservation Act (EPCA) (Pub. L. 94-163). Subsequently, EPCA was amended by the National Energy Conservation Policy Act (NECPA) (Pub. L. 95-619). References in this notice to the Act, or to sections of the Act, refer to EPCA as amended by NECPA. Among other program elements, Section 323 of the Act requires that standard methods of testing be prescribed for covered products. Test procedures appear at 10 CFR 430, Subpart B.

## II. DISCUSSION OF COMMENTS

In general, the received comments were supportive of the proposed amendments; consequently for most of the issues, today's notice prescribes the amendments as proposed. For each issue, the following discussion sections repeat the background information that was presented in the proposal followed by a characterization of the comments received and a statement delineating the disposition of the issue with regards to today's final rule. Also, some additional issues were brought up during the comment period. Where appropriate, those issues are also discussed here today.

## A. Furnace Test Procedure

Test procedures for furnaces were prescribed by DOE by notice issued May 2, 1978, 43 FR 20155 (May 10, 1978). DOE amended the furnace test procedures by notice issued August 4, 1980, 45 FR 53720 (August 12, 1980). The amendment included provisions for pulse combustion and condensing furnaces and technical revisions. Subsequently, DOE has become aware of additional areas of concern through cooperative efforts with the furnace industry and by the test procedure waiver process. Specifically, manufacturers of condensing furnaces and boilers felt an improved method of testing was warranted to determine the

amount of beneficial condensation produced in their designs; manufacturers of boilers felt the test procedure needed further clarification in the area of advanced controls (modulating controls and pump delay controls); utilities and research groups identified the need for improving the test procedure with regard to stack dampers and draft hood designs; and the furnace industry expressed the need for the test procedure to specifically outline the method of test for units installed in "isolated combustion systems." On the basis of the information submitted under the waiver process, research done by the National Bureau of Standards (NBS), and other available information, DOE proposed to amend the furnace test procedure to address all these concerns. 48 FR 28014 (June 17, 1983) hereafter referred to as the June 17 proposal. Subsequently, a public hearing was held on June 29, 1983 and comments were received regarding the proposed rule.

## 1. ANSI/ASHRAE Standard 103-82

When the test procedures were initially developed in 1976 and 1977, existing commercial standards were referenced wherever possible. The final test procedures prescribed by DOE reference sections from many commercial standards developed by various consensus standard organizations, such as ASHRAE, Air-Conditioning and Refrigeration Institute, American National Standards Institute, Association of Home Appliance Manufacturers, and Underwriters Laboratory. However, at the time when DOE was developing test procedures for residential furnaces and boilers, no commercial standard existed from ASHRAE, or any other organization, that could meet the needs of the Act. Specifically, no commercial standard was available for referencing by DOE that could be used to determine the annual energy consumption of a furnace as outlined in EPCA. Thus, DOE and NBS set out to develop a test procedure methodology that would satisfy the legislative requirements. This effort included referencing portions of certain commercial standards for the purposes of including test set up and instrumentation provisions that were already established in the test methods used by the furnace industry at that time.

As mentioned above, final test procedures for residential furnaces were prescribed by DOE, pursuant to the Act, on May 10, 1978. In 1980, the test procedures were amended to include new furnace designs and to make some technical revisions. Following the



establishment of the test procedure amendments ASHRAE initiated the development of a standard method of measurement and test for residential furnaces and boilers that could be referenced by DOE in its test procedures. ASHRAE established a Standards Project Committee, with representation from Industry, Government, and Research groups, for the purpose of developing a consensus standard for testing furnaces and boilers. The resulting commercial standard is now available entitled "Methods of Testing for Heating Seasonal Efficiency of Central Furnaces and Boilers ASHRAE 103-82." DOE believes the referencing of the ASHRAE Standard will not result in a difference in efficiency ratings since the Project Committee has essentially adopted the existing DOE test methods.

DOE is required by Section 32 of the FEA Act to alert the public to the use and background of commercial standards in a proposed rulemaking and, through the comment and hearing process, allow interested persons to make known their views regarding the appropriateness of the use of particular commercial standards in any proposed rulemaking.

In addition to identifying the organization which promulgated the standard to be used, Section 32 requires that the Secretary make a judgmental statement concerning the organization process of promulgating any of its standards (i.e. are all interested persons given adequate notice, is there effective representation of all interested persons in the membership, are all proceedings of the organization made available to the public, and can any interested persons obtain reconsideration and review of any action taken by the organization).

In the June 17, 1983 proposal it was the judgment of DOE that ASHRAE standards are not developed in a manner which provided for public participation, comment and review. ASHRAE (ASHRAE, No. 4, at 1),<sup>1</sup> American National Standards Institute (ANSI) (ANSI, No. 5 at 1), and GAMA (GAMA No. 12, at 1), all took exception to this statement and offered that ASHRAE and ANSI<sup>2</sup> procedures do

clearly provide for public participation, comment, and review. DOE has reviewed the procedures of these organizations and agrees that, if complied with, these procedures will provide for public participation, comment, and review.

In addition, as required by Section 32(c) of FEA Act, DOE has consulted with the Attorney General and the Chairman of the Federal Trade Commission (FTC) regarding referencing ASHRAE Standard 103-82 into furnace test procedures. (Letters from DOE to the Attorney General and FTC dated July 26, 1983.)

All comments received concerning the use of ASHRAE Standard 103-82 expressed approval. In addition, neither the Attorney General nor the Chairman of FTC recommends against such referencing or use. (Letter from Attorney General dated September 14, 1983, letter from FTC dated September 12, 1983.) Therefore, DOE is referencing in today's final rule the ASHRAE Standard 103-82.

Since the standard has received approval from the American National Standards Institute (ANSI), the standard has been designated as the ANSI/ASHRAE Standard 103-82. Today's final rule reflects this change.

## 2. Modulating Furnaces and Boilers

The furnace and vented heater test procedures were developed to reflect the fact that furnaces, boilers and vented heaters operate either at the maximum firing rate or are off. This is called single step control. For heating equipment that is designed to operate at various firing rates, both the vented heater and furnace test procedures require that the testing is to be based only on the maximum firing rate. It was thought that the results of such testing were reasonably accurate and further complication of an already complicated test procedure was not warranted. However, since that time, two vented heater and three furnace manufacturers have petitioned the Department's Office of Hearings and Appeals (OHA) for an Exception from the existing test procedure on the grounds that such procedures are not appropriate for their units which have modulating controls.<sup>3</sup>

<sup>1</sup> Dearborn Stove Company, Case No. BEE-0883, *Federal Energy Guidelines*, 6 DOE 81,060.

Atlanta Stove Works, Case No. BEE-0983, *Federal Energy Guidelines*, 6 DOE 81,109.

Raypak, Inc., Case No. HXE-0012, *Federal Energy Guidelines*, 9 DOE 81,038.

Teledyne Laars, Case No. HXE-0013, *Federal Energy Guidelines*, 9 DOE 81,038.

A. O. Smith Corporation, Case No. HXE-0018, *Federal Energy Guidelines*, 81,042.

These petitioners felt that modified test procedures are necessary to account for operation with fuel modulation. OHA agreed with the petitioners and has granted an exception in each case. However, no testing provisions were specified in these grants regarding modulating controls. A revised procedure which accommodates two types of fuel modulating controls was developed by NBS and the June 17 proposal proposed this revised procedure.

The two types of modulating controls are:

1. "Step-modulating thermostat control" means a control that reduces burner fuel input rate if the heating load is light, or gradually increases or steps-up the heat input to meet any higher heating load that cannot be met with the low firing rate.

2. "Two stage thermostat control" means a control that either cycles a burner at the reduced heat input rate and off, or cycles a burner at the maximum heat input rate and off.

A. *Proposed Amendment*—The June 17 proposal included methods for measuring the Annual Fuel Utilization Efficiency (AFUE) for modulating furnaces and boilers by devising two new measures, weighted average steady state efficiency and weighted average part load efficiency. The methods are more fully described in the technical support document, *A Test Method and Calculation Procedure for Determining Annual Efficiency for Vented Household Heaters and Furnaces Equipped with Modulating-Type Controls*, NBSIR 82-2497, May 1982.

The June 17 proposal outlined calculation methods for two types of variable firing rate controls, i.e., step-modulating and two stage. All comments received expressed approval of these methods. However, Teledyne Laars and Raypak, Inc. requested clarification in the final rule on which calculation method is to be used when testing their particular design of two stage control. See Teledyne Laars and Raypak, Inc. No. 9, at 4. Specifically, the June 17 proposal assumes that two stage controls operate either from off to minimum and then to off, or from off to maximum and then to off. Their design of modulating controls differ in that they can operate from off to minimum to maximum and back to minimum (more than once) without ever going through an off cycle. NBS has determined that the proposed test method for step modulating controls is appropriate for this design of controls. Thus, the final rule is the same as the proposed rule with the addition of clarifying language

<sup>1</sup> Comments on the rulemaking were given docket numbers. Citations to comments provide the docket numbers, unless the comment was submitted as part of an oral presentation, in which case the citation is to the date and the numerical order of the presentation.

<sup>2</sup> ASHRAE Standards 103-82 received approval as an ANSI Standard on June 21, 1983.



involving user-evaluation of the control. Specifically, this control design is defined as a step modulating control in the definitions.

Also, in early comments, Raypak, Inc. expressed concerns about the appropriateness of the proposed provisions for modulating boilers in general. See Raypak, Inc., No. 1, at 1. However, the final comments from Raypak, Inc. endorsed these provisions as proposed. See Raypak, Inc., No. 6.

**B. Oversize Factor of Furnaces and Boilers**—In the existing furnace test procedure, the value of efficiency used to determine the estimated annual operating cost is prescribed to be constant for all design heating loads regardless of the extent that the capacity of the installed furnace exceeds the design heating load, i.e. the extent of oversizing. The existing furnace test procedures are only applicable to units with single-stage controls. Consequently, where the FTC labeling rule for furnaces and boilers requires annual operating costs for various design heating load to be determined, these costs are based on a single value of efficiency. NBS has found that oversizing has little effect on the efficiency of furnaces and boilers equipped with single stage controls.

However, the efficiency of modulating furnaces and boilers depend on the fraction of the heating load that occurs during the various firing rates. In turn, the fraction is dependent on the extent of oversizing. Consequently, for modulating units, DOE believes the test procedure should reflect the change in efficiency due to the differences in oversizing. This would allow the FTC labeling program to present the consumer with a valid evaluation of modulating furnaces and boilers.<sup>4</sup> Specifically, the labeled operating costs under each design heating load that appears on the FTC EnergyGuide Fact Sheet, will be based on the appropriate value of efficiency for the degree of oversizing that each design heating load represents.

Consequently, the June 17 proposal provided for a separate efficiency and annual cost calculation to be made for each oversizing factor, corresponding to each typical design heating load listed in Table 1 of the test procedure.

Teledyne Laars and Raypak, Inc. objected to the requirement to calculate the efficiency for each degree of oversizing. See Teledyne Laars and Raypak, Inc., No. 9, at 2. It is their belief

that disclosure of these different efficiencies would be of little or no use to the consumer since most consumers do not understand what oversizing means and are not likely to use FTC EnergyGuide fact sheets in any event. DOE disagrees with this contention and fails to see any merit to reducing the accuracy of a test procedure on such a basis. The procedure to determine the different efficiencies is simply an arithmetic exercise with no additional testing required. Since the energy savings potential of modulating controls depends on the extent of oversizing, DOE feels it is justified to require these additional calculations.

These same commenters stated that the proposed test procedures do not provide for the use of zone controls for boilers, and therefore will not recognize the benefits of such widely used systems. See Teledyne Laars and Raypak, Inc. No. 9, at 3. DOE realizes this shortcoming but is reluctant to expand the test procedures to allow different ratings for installations with and without zone controls. As with other installation variables (i.g. chimney height) DOE has sought to be as representative as possible. Since most residential boiler installations are without zone controls, DOE believes it appropriate to have the efficiency ratings based on this single condition. Further, the expansion necessary to accommodate zone controls would be significantly more than that already objected to above (i.e. an efficiency for each degree of oversizing). This expansion would apply not only to modulating boilers but to all boilers. Therefore, DOE is not considering expanding the test procedures to accommodate zone controls at this time.

Hydrotherm Inc., a manufacturer of boilers which are equipped with modulating controls, has been granted a test procedure waiver to use the modulating control test provisions outlined in the June 17 proposal. 48 FR 55020 (December 8, 1983). The effective date of the final rule constitutes the official expiration of the test procedure waiver by Hydrotherm Inc. (F-009). Today's provisions reflect exactly the provisions granted in the Hydrotherm waiver (F-009).

Also, since the above mentioned test procedure exceptions, HXE-0012, HXE-0013, and HXE-0018, (delineated in footnote 3) were partially granted on the basis that no modulating control provisions were included in the existing test procedures, the effective date of this rule constitutes the expiration of those exceptions with regard to modulating controls. Further, those exceptions are

superceded on the effective date of today's rule since all the grounds for these exceptions are now addressed. (See Section II a 9 "Pump Delay Boiler Controls" below).

### 3. Condensing Furnaces and Boilers

**A. Direct Condensate Method**—DOE has granted waivers to Hydrotherm, Inc. (Hydrotherm), Lennox Industries, Inc. (Lennox), Arkla Industries, Inc. (Arkla), Amana Refrigeration, Inc. (Amana), Duo/Matic Olsen, Inc. (Duo/Matic) and Heil Quaker Corporation (Heil) from the existing test procedures for furnaces and boilers because the prescribed test procedures do not adequately consider the improvement in energy efficiency attributable to the condensing and the removing of water in the flue products. 46 FR 34621 (July 2, 1981). 47 FR 32471 (July 27, 1982). 47 FR 57987 (December 29, 1982). 48 FR 28531 (June 22, 1983). 48 FR 41213 (September 14, 1983). 48 FR 41215 (September 14, 1983), respectively.

The test procedure waivers specified that the manufacturers use the test method outlined in Appendix C of the NBS report, *Recommended Testing and Calculation Procedures for Estimating the Seasonal Performance of Residential Condensing Furnaces and Boilers*, NBSIR 80-2110, April 1981. The June 17 proposal was identical to the requirements of the waivers except it proposed a six cycle test in lieu of three cycles. Hydronics Institute (HI), Carrier Corp., GAMA and Trane indicated that the six cycle test was burdensome especially for those designs that have repeatable condensate collection rates. See HI, No. 8, at 4; Carrier, No. 10, at 4; GAMA, No. 12, at 3; and Trane, No. 14, at 2. Also, the one hour period for the steady-state collection test was thought to be excessive by these commenters. NBS analyzed these issues and agrees with the recommended reduction in the number of required cycles for units with repeatable condensate collection rates and the reduction in steady-state testing time.

Accordingly, today's final rule prescribes a ½ hour steady-state test and a three cycle test for those furnaces and boilers with repeatable condensate collection rates. A furnace or boiler is considered to have a repeatable condensate collection rate if it can demonstrate a standard deviation less than 20 percent of the mean per cycle condensate collected after three cycles. For those furnaces and boilers which do not demonstrate a repeatable condensate collection rate in these first three cycles, and additional three cycles are required irrespective of variability.

<sup>4</sup> FTC labeling program for furnaces consists of a requirement to produce "EnergyGuide Fact Sheets" that report estimates of annual operating costs for several different design heating loads (degrees of oversizing).



The effective date of this final rule constitutes the official expiration of the following waivers: Hydrotherm (F-002), Lennox (F-004), Arkla (F-005), Amana (F-006), Duo-Matic/Olsen (F-008) and Heil (F-010). Today's rule differs from what was granted in these six waivers in that one hour steady-state test is changed to a 30 minute test and the cyclic test may be 3 cycles in length instead of 6 cycles in length.

#### 4. Energy Efficiency Descriptor

Although not directly related to any of the issues raised in the June 17 proposal, many commenters discussed the need for an energy efficiency descriptor (energy efficiency rating) to account for the electrical energy used by a fossil fueled furnace in addition to the fossil fuel used. The descriptor AFUE only accounts for the fossil fuel efficiency. See TRD, No. 7, at 1; Carrier, No. 10, at 1; and GAMA, No. 12, at 8. The proposed provisions for modulating controls drew these comments since in most modulating designs improved fuel efficiency (AFUE) is obtained at the expense of additional electrical energy consumption, (e.g. increased blower run time). The existing regulation for determining annual operating costs does reflect this concept, since electrical and fuel costs are separately determined and then summed. The commenters felt that in addition to the annual operating cost provisions, an energy efficiency descriptor needs to be added that will fairly disclose to the consumer the relative performance of different designs of furnaces that use both fossil fuel and electricity. Commenters felt the situation is exacerbated by FTC's Labeling program, where for furnaces the dominant disclosure is AFUE and annual operating costs are relegated to the bottom of the Fact Sheet in grid format. The consumer may make a purchasing decision solely on the AFUE and not consider the electrical cost as well. Carrier delineated an example of the misleading nature of comparisons based on AFUE by showing where a higher AFUE furnace had an actual higher annual operating cost. See Carrier Corp., No. 10, at 2. Obviously, this outcome was dependent on assumed relative costs of the fuel and electricity. Other relative costs assumptions could lead to the opposite outcome, i.e., higher AFUE, lower operating costs. The commenters suggested the adoption of a new efficiency descriptor that includes an average electricity to fuel cost ratio. Any rankings developed from this descriptor would be identical to that developed on the basis of annual operating costs using the same average

electricity to fuel costs ratio. DOE sees some merit to an efficiency descriptor based on the average electricity to fuel cost ratio but feels there exists, already in DOE procedures, a superior method of rating a furnace's performance in all costs scenarios, not just average costs scenarios. The DOE procedures currently provide the method of calculation needed to explicitly detail the electrical energy cost and the fuel energy cost for any furnace.

Therefore, for the reasons discussed above today's final rule does not include a new energy efficiency descriptor. However, DOE will continue to examine this subject and may consider revisions at a later date.

#### 5. Furnaces Without Draft Relief

The 1980 amendments clarified how to test gas furnaces equipped with reduced draft fans and no draft relief device. Specifically, a definition of "direct exhaust" was added and provisions to allow testing of direct exhaust systems were specified. In addition, the Carrier Corporation was granted a test procedure waiver for its induced draft gas furnace with a draft safeguard system. 46 FR 22799 (April 21, 1981). The waiver specified that the unit with a draft safeguard system is tested according to the same provisions specified in the 1980 amendments for "direct exhaust" systems.

The June 17 proposal would allow all manufacturers of similar designs to use the provisions granted to Carrier's draft safeguard system.

All commenters that addressed this issue agreed with the proposal. See HI, No. 8, at 4; Carrier, No. 10, at 3; ETL, No. 11, at 4; and Trane, No. 14, at 2. However, both GAMA and Hydronics Institute suggested that the term "draft safeguard system" is proprietary and should be eliminated. DOE agrees with the commenters, and today's final rule adopts the proposal except that the term "draft safeguard system" is eliminated.

The effective date of today's rule constitutes the official expiration of the Carrier waiver (F-001). Future rulemakings may consider the need to specify exactly how to determine this percent flue flow if it is found that today's provisions lead to difficulty in replicating the procedure.

#### 6. Hot Water Boiler Specifications

Existing test procedures for non-condensing hot water boilers specify testing at a 120°F temperature rise and a 200°F outlet water temperature. These specifications generally are not difficult to achieve and thereby reduce the testing burden on manufacturers. However, some manufacturers of finned

tube boilers were granted test procedure exceptions because their boilers cannot be tested safely at these conditions. (Exception requests by Teledyne Laars and Raypak, Office of Hearings and Appeals, Case Nos. DEE-3439 and DEE-3950). The August 1980 amendments to the furnace test procedures prescribed test procedures for finned tube boilers. Specifically, these amendments required boilers to be tested at a 20°F to 40°F temperature rise and a 200°F outlet water temperature.

Since the 1980 amendments, Energy Kinetics (F-003), a manufacturer of boilers which are designed with low thermal mass, received a test procedure waiver to allow testing of its boilers under the provisions prescribed for finned tube boilers. 46 FR 58732 (December 3, 1981).

The June 17 notice proposed entirely new provisions, specifically all non-condensing hot water boilers are to be tested with a return inlet water temperature of at least 120°F and a water temperature rise of at least 20°F. DOE believed that all non-condensing hot water boilers, including finned tube boilers and low thermal mass boilers, generally operate at these conditions.

Teledyne Laars and Raypak agreed with these provisions but felt the exact test apparatus necessary to supply the 120°F water should be specified. See Teledyne Laars and Raypak, Inc., No. 9, at 4. DOE disagrees and would like to avoid further specification, because in this case no increase in test procedure accuracy is likely.

The effective date of today's final rule constitutes the official expiration of the water specifications provisions of the test procedure waiver granted to Energy Kinetics (F-003).

#### 7. Thermal Stack Dampers

The June 17 proposal proposed a test method to directly measure the off-cycle losses for furnaces and boilers equipped with thermal stack dampers. These losses are the off-cycle infiltration loss ( $L_{i,OFF}$ ) and the off-cycle sensible loss ( $L_{s,OFF}$ ) which have been estimated in the past by the use of off-cycle draft factors for flue gas flow ( $D_F$ ) and for stack gas flow ( $D_S$ ). Currently, the off-cycle draft factors are assigned values in the existing furnace test procedure and these draft factors are adjusted if the unit is equipped with an electro-mechanical stack damper; this adjustment factor is the stack damper effectiveness factor  $D_o$ .

For furnaces and boilers with thermal stack dampers, the energy efficiency could not be accurately determined by using the value of  $D_o$  that was



developed for electric-mechanical stack dampers. This is based on the fact that thermal stack dampers typically have changing off-period leakage rates, whereas electro-mechanical dampers typically have relatively constant off-period leakage rates. Also, the leakage rate is strongly dependent on temperature for thermal stack dampers whereas it is not dependent on temperature for electro-mechanical stack dampers.

The June 17 proposal allowed for the direct measurement of off-cycle losses by measuring the concentration of a tracer gas in the flue and in the stack during an appropriate off-cycle period and thereby eliminating any need for assigned draft factors. The method is based on the tracer gas method described in Appendix A of the NBS milestone report, *Recommendations to DOE on Modifications of Assigned Factors for Test Procedures for Vented Gas and Oil Fueled Heaters*, May 1980, and in Appendix D of ANSI/ASHRAE Standard 103-82. See NBS letter report, *An Analysis of Burner On and Off Periods and Their Effect on Part-Load Efficiency for Furnaces and Boilers Equipped with Modulating Controls*, January 1983.

Comments received regarding this issue approved of the proposal. See HI, No. 8, at 5 and Trane No. 14, at 2. However, GAMA's test procedure committee pointed out a number of questions that needed to be clarified before GAMA could fully support the provisions (e.g. should the thermal stack damper be in place for all parts of the test? should the thermal stack damper be insulated during testing? should the provision apply to furnaces with power burners?) See GAMA, No. 12, at 6. GAMA stated that the provision needed to be repropose to allow comment on the complete procedures. DOE agrees and is reserving those provisions relating to thermal stack dampers until testing details and calculation procedures as required can be developed. These details and procedures are still being developed by the National Bureau of Standards. Thus, DOE will include these provisions in a separate notice.

#### 8. Improvement in Stack (Flue) Damper Evaluation in the Test Procedures

Since the development of DOE furnace test procedures, it has been suspected by many interested parties that the actual energy efficiency improvement attributable to electro-mechanical stack (flue) dampers is less than that predicted in the test procedures. At this time, DOE is aware of analyses (both theoretical and field

analyses) that support this conclusion. See *Proposed Framework for Furnace and Boiler Test Procedure Modifications*, a report to U.S. DOE Office of Buildings Energy Research and Development by Arthur D. Little, Inc., November 1982.

The current test procedure evaluates the effectiveness of a stack (flue) damper by comparing the area of the damper plate to the area of the stack. This simplified evaluation method ignores damper closing times. Thus, it is deficient in that it likely results in overstatements of efficiency. Also, the existing method discourages manufacturers from using quicker closing dampers.

The June 17 notice proposed that the direct measurement (tracer gas) method proposed for thermal stack dampers be allowed as an option for other than thermal stack flue dampers.

As with the provisions proposed for thermal stack dampers, all comments received expressed merit for the provisions. See HI, No. 8 at 5; GAMA, No. 12, at 6; and Trane, No. 14, at 2. However, since these provisions for all stack damper designs use essentially the same test method as was proposed for thermal stack dampers, the same questions as to the completeness of the proposed provisions were also raised. DOE agrees with these comments, therefore, DOE is reserving those provisions relating to the direct measurement method of testing all designs of stack dampers until testing details and calculation procedures as required can be developed.

#### 9. Pump Delay Boiler Controls.

The June 17 proposal for pump delay boiler controls included a test method similar to that for time delay blower controls for furnaces, i.e. during testing the circulating pump is allowed to operate in accordance with its own control strategy. Maximum allowable time delays, a minimum return water temperature and a method for calculating the estimated annual operating cost to reflect the additional run time of the electrical circulating pump were proposed.

HI agreed with the proposal, especially for those control strategies that are time actuated. See HI, No. 8, at 6. However, HI felt clarification of the test method with regard to temperature actuated controls was required. It recommended a 15 minute fixed time delay be used for these controls. NBS reviewed these comments and also recommends the incorporation of this provision. Consequently, DOE has incorporated these provisions into today's final rule.

Three boiler manufacturers were granted test procedure exceptions which allowed testing under these provisions for pump delay. (Previously mentioned in footnote 3 were Raypak, Teledyne-Laars, and A. O. Smith). Since both pump delay and modulating controls are addressed, the effective date of today's final rule constitutes the official expiration of exceptions HXE-0012, HXE-0013, and HXE-0018.

DOE also received comments regarding the need to specify clearly the procedures for testing boilers designed for continuous pump operations. See ETL, No. 11, at 1. This is done in today's rule by allowing such designs to have their laboratory testing conducted under continuous pump operation. In addition, the calculations are appropriately adjusted to reflect continuous operation.

#### 10. Improved Method of Determining the S/F Factor for Furnaces and Boilers

**A. Gas Furnaces and Boilers**—The June 17 proposal included a method for calculating the S/F factor (average ratio of stack gas mass flow rate to flue gas mass flow rate at steady-state operation). The S/F factor is used to measure the on-cycle infiltration losses and the off-cycle infiltration losses in the furnace test procedure. The existing method is based on assigned values. The proposed method is based on the flue and stack measurements of CO<sub>2</sub> concentration, which already are required in the existing test procedures.

All comments received regarding these issues agreed with the proposal. See HI, No. 8, at 4; Carrier, No. 10, at 4; GAMA, No. 12, at 6; and Trane, No. 14, at 3. However, GAMA and the Hydronics Institute pointed out that though the flue and stack measurements of CO<sub>2</sub> concentration are already required for gas units with integral draft diverters, they are not required for units equipped with draft hoods. In consideration of this, the commenters suggested a 2-year phase in period for gas units equipped with draft hoods since data is not on file for previously tested units and thus additional testing is necessary to develop the new S/F factors. DOE agrees and has incorporated the suggested 2-year phase in period for units equipped with draft hoods. Specifically, the draft hood units shall have the option of using the existing assigned value or today's method for a 2-year period. Thereafter only today's method may be used.

**B. Oil Furnaces and Boilers**—Based on tests conducted by NBS, it was found that the value of S/F for oil furnaces and boilers is relatively constant, therefore, the assigned value of S/F is not likely to



result in marked inaccuracy. Also, oil furnaces and boilers are commonly marketed and sold without a barometric draft regulator. Thus, for those models, a laboratory determination of an S/F value is inappropriate.

Therefore, DOE proposed to allow the use of an assigned value of S/F oil furnaces and boilers and at the manufacturers option a measured value of S/F for oil furnaces and boilers that have the barometric regulator shipped with the unit. As with the gas furnaces and boilers, CO<sub>2</sub> concentrations are used to determine the measured value of S/F.

No opposing comments were received on this issue. Therefore, DOE has adopted the provisions as proposed.

#### 11. Isolated Combustion System (ICS)

The June 17 notice addressed how DOE test procedures should be applied to determine a representative energy efficiency for units installed in an "isolated combustion system." DOE proposed that an assigned jacket loss value of 1 percent may be used, as an option, by all designs of furnaces, if an outdoor rating is made. Since many of the units in ICS installations are designed and intended for indoor installations, this will allow manufacturers to produce indoor and outdoor ratings of any design without increasing testing burden. Additionally, DOE proposed that representations specifically regarding ICS installations be based on the outdoor test method with one half of the jacket loss deduction.

All commenters supported the proposal regarding ICS systems. See HI, No. 8, at 6; Carrier, No. 10, at 3; GAMA, No. 12, at 5; and Trane, No. 14, at 3. Therefore, the provisions are adopted as proposed.

In addition, HI and GAMA suggested that this issue further be clarified by revising the definition of "outdoor furnace" in the ASHRAE/ANSI Standard 103-82. See HI, No. 8, at 6, and GAMA, No. 12, at 5. Basically, this suggestion is to require a statement on the furnace itself that indicates "intended for outdoor use" if the manufacturer is to consider his design an outdoor furnace in the test procedures. GAMA indicated it would petition the appropriate ASHRAE revision committee regarding this issue.

#### 12. Additional Issues Regarding Furnace Test Procedures

There were a number of additional issues brought up in the comments regarding the furnace test procedures. Although in most cases, these comments were not directly related to the June 17

proposal, they are discussed here for the information of all interested parties.

**A. Test Procedure Applicability to Furnaces with High Mass Heat Exchangers**—The 20th Century Heating and Ventilating Company (20th Century) believed the June 17 proposal failed to address the company's long-standing objections to the DOE furnace test procedures. See 20th Century, No. 2. Twentieth Century company believes that furnaces with higher mass are inherently more efficient than the AFUE predicted by using DOE's "average cycle" methodology. Twentieth Century contends that its design will continue to deliver heat beyond the time frame of the average cycle; thereby keeping the thermostat satisfied and keeping the burner off beyond the time the test procedures assume a furnace should recycle. This postponing of burner on time, called a "free ride" by the commenter, is the basis of the company's contention that its furnace is inherently more efficient than predicted by DOE's test procedures. The fundamental error in this contention is the belief, by the company, that the house thermostat will be satisfied as long as some heat is being delivered by the furnace. This belief is incorrect since the room temperature can decrease in spite of the delivered heat; thus, the thermostat is not satisfied and another burner cycle is needed even though the furnace blower may still be delivering some heat. The DOE test procedures allow for the rating of furnaces with various blower run times. In fact, if the design is such that the furnace would deliver heat in excess of the amount that would be delivered during the average cycle time frame, the test procedures allow ratings based on continuous fan operation.

DOE believes the existing procedures do adequately and fairly allow for the rating of furnaces with high mass heat exchangers. Therefore, DOE sees no need to further address this issue.

**B. Deletion of Test Procedures for Electric Furnaces**—Trane, Inc. recommended that "the rating of electric furnaces be deleted from the DOE test procedures since they are essentially 100 percent efficient and perpetuation of their rating with resulting FTC labeling is contributing to a waste of industry and government resource time with no benefit to the consumers." See Trane, No. 14, at 1.

DOE believes the use of the test procedure itself constitutes little or not testing burden to the manufacturer. Test procedure results and the FTC labeling program provide consumers with useful information. While there is little variation in electric furnace efficiency,

the DOE is not deleting the provisions. If the commenter has any proposed revisions to the FTC labeling program, they should be addressed to the FTC.

**C. Jacket Loss Testing Accuracy**—The existing DOE test procedures refer to the industry standards jacket loss test when determining the efficiency of furnaces installed outdoors. The jacket loss provisions of these standards of the American National Standard Institute (ANSI) (ANSI Z21.47 and ANSI Z91.1) were incorporated into the ANSI/ASHRAE 103-82 standard. These provisions as published in the ANSI/ASHRAE 103-82 was criticized by the ETL Laboratories as being extremely vague and subject to varied interpretations. See ETL, No. 11, at 1. ETL suggests a more formal and detailed jacket loss test be developed.

DOE will consider this issue as a possible area for future test procedure rulemaking. Any data, analysis, or general comment from interested parties including ANSI are welcome.

Comments were also received that the proposed jacket loss test failed to assign an adjustment factor, C<sub>j</sub>, for finned tube boilers as was done in the existing test procedures. See Teledyne Laars and Raypak, Inc., No. 9, at 4, and GAMA, No. 12, at 5. DOE regrets this inadvertent error and has included in today's rule the provision that C<sub>j</sub> = 1.0 for finned tube boilers.

**D. Need to Include a "Preamble" to the Test Procedures**—Trane, Teledyne Laars and Raypak and GAMA recommended that a preamble be included in the test procedures to clarify their intent. See Trane, No. 14, at 1, Teledyne Laars and Raypak, Inc., No. 9, at 5, and GAMA, No. 12 at 9. Basically, the preamble would serve to point out the inability of the test procedures to predict the energy performance of a furnace in every installation. Rather, it would point out that their use is for comparison purposes and thus installation variables are only representatively accounted for. DOE agrees with this statement. Thus, this discussion constitutes a "preamble" to the test procedure as requested.

GAMA and Trane suggested DOE provide that: "the procedures are not intended to provide comparisons with other types of heating devices such as heat pumps, space heater, etc." DOE strongly objects to this additional wording because this cross-product comparison was intended by DOE in developing the different test procedures for the various types of heating devices. Efforts were made by DOE to promulgate consistent test procedures that will allow, to the extent possible,



informed purchase decisions across types of heating devices. In addition, the Act requires this when it states the test procedures are to contain measures of energy consumption which are likely to assist consumers in making purchasing decisions.

### B. Vented Heater Test Procedure

The vented heater test procedure was prescribed by DOE by notice issued May 2, 1978, 43 FR 20182 (May 10, 1978). Several manufacturers petitioned DOE to expand the vented heater test procedure to include modulating vented heaters and manually controlled vented heaters. Other manufacturers felt that an improved method of testing was needed for vented oil heaters equipped with vaporizing-type burners. In 1980, the *Ad Hoc* Technical Committee of GAMA, presented a simplified testing method to DOE. The method was intended to be an optional procedure that reduces the testing burden on manufacturers. On the basis of the information submitted by the petitioners, information from GAMA, research conducted by NBS, and other available information, DOE proposed to amend the vented heater test procedure to address these concerns in the June 17 proposal. Subsequently, a public hearing was held on June 29, 1983 and comments were received regarding the proposed rule. DOE today is amending the vented heater test procedure to expand the coverage of the test procedure while at the same time reducing the testing burden.

#### 1. Simplified Vented Heater Test Procedure

For vented heaters equipped without manual controls or without thermal stack dampers, DOE proposed a simplified test procedure. The simplified procedures addressed those heaters with modulating controls.

No disapproving comments were received regarding the simplified procedures. See GAMA, No. 12, at 10. Therefore, DOE is adopting the simplified procedure as proposed in the June 17 proposal.

Also, since the above mentioned test procedure exceptions BEE-0883 and BEE-0983 (delineated in foot note 3) were granted partially on the basis that no modulating control provisions were included in the existing vented heater test procedures, the effective date of today's rule constitutes the expiration of those exceptions with regard to modulating controls.

#### 2. Manually Controlled Vented Heaters

The June 17 proposal would allow for a determination of efficiency of

manually controlled heaters by use of a weighted-average steady-state efficiency. Since a typical manual control allows for several firing rates, this weighted average steady-state efficiency is based on the manually controlled heater operating at 50 percent of maximum heating output rate. However, GAMA testified that since there exist manually controlled heaters that have only a single firing rate and for this design, the averaging of efficiencies method is inappropriate. See GAMA, June 29. DOE agrees and today's rule provides that for such designs the weighted average steady-state efficiency is that steady state efficiency when tested at its single firing rate.

Since both modulating controls and manual controls are addressed, the effective date of this final rule constitutes the official expiration of exceptions BEE-0883 and BEE-0983 (delineated in footnote 3).

#### 3. Vented Heaters Equipped With Thermal Stack Dampers

Since no comments objecting to the June 17 proposal for testing of vented heaters with thermal dampers were received, DOE is adopting the proposed provisions in today's final rule.

#### 4. Floor Furnaces

Floor furnaces are a class of vented heaters that are specifically designed to be installed in a crawl space under a home. GAMA suggested that the similar provisions allowed ICS furnaces be allowed for floor furnaces. Specifically, ICS furnaces are allowed an assigned jacket loss of 1 percent and an adjustment factor to account for outdoor and cycling conditions of 1.7. GAMA asks that floor furnaces be allowed an assigned jacket loss of 3 percent and an adjustment factor of 1.7. See GAMA, No. 12, at 12.

NBS has reviewed these comments and recommends that the jacket loss continue to be required to be measured for floor furnaces since reduced jacket losses represent the single most important improvement available to floor furnaces. Allowing an assigned value reduces the incentive for improving jacket losses. Consequently, DOE is not allowing an assigned jacket loss for floor furnaces.

Regarding the issue of a lower adjustment factor for floor furnaces, DOE agrees that some reduction of adjustment factor is appropriate for reasons similar to ICS's (i.e. not entirely outside, protected from the wind, etc.). However, DOE believes that representatively, floor furnace installations more closely resemble outdoor installations than ICS

installations. Therefore, the appropriate adjustment factor for floor furnace jacket loss should be between that which is allowed for ICS furnaces (1.7) and what is allowed for outdoor vented heaters (3.93). The factor of 2.8 represents the midpoint of these two cases.

### C. Unvented Heater Test Procedures

A test procedure for unvented heaters, using electricity, natural gas, or propane, was proposed by DOE on May 4, 1977, 42 FR 23860 (May 11, 1977). A test procedure for electric heaters was prescribed by DOE on May 2, 1978, 43 FR 20128 (May 10, 1978). A final test procedure was not prescribed for unvented natural and propane gas heaters at that time because the Consumer Product Safety Commission (CPSC) proposed to ban the sale of these heaters. 43 FR 6235 (February 14, 1978). CPSC has issued a safety standard in place of a sales ban (16 CFR Part 1212). Today, DOE is prescribing a test procedure appropriate for unvented natural and propane gas heaters as proposed.

In addition, DOE is today prescribing a test procedure for unvented kerosene heaters as proposed. Kerosene heaters were not considered during the previous rulemaking process essentially because these heaters were not widely marketed at the time of the original proposal. DOE believes that a test procedure for kerosene heaters is presently needed since these heaters are now widely marketed.

All comments received regarding these procedures approved of the provisions as proposed. In particular, the kerosene industry elaborated on the appropriateness of the implied 100 percent fuel efficiency. The Kerosun Company testified that since the operation of an unvented heater does not cause an additional infiltration loss to the home, and since the combustion of the fuel is essentially complete, the implied 100 percent fuel efficiency is entirely appropriate. See Kerosun, Inc. June 29. Therefore, based on this testimony and due to the fact that no opposing testimony was received, DOE is prescribing today the provisions that were proposed for these types of heaters.

Arizona Public Service Company (APSC), a public utility, generally supported the proposed amendments for unvented heaters but commented upon the unsafe nature of unvented gas-fired room heaters. See APSC, No. 13. The safety of such heaters is not within the jurisdiction of DOE.



#### D. Estimated Operating Cost for Vented and Unvented Heaters

For vented and unvented heaters, DOE is adopting the proposed method to determine an estimated operating cost per million British thermal units (Btu) output. In the past, several commenters expressed concern over the validity of an estimated annual operating cost for vented and unvented heaters. Most felt that any selection of a representative hours of annual use would be inappropriate for these heaters considering the large variability involved. Secondly, an appropriate efficiency determination was needed for vented heaters with modulating controls. As with furnaces, heaters with modulating controls would have a variable efficiency and operating costs depending on the extent of oversizing.

A valid estimated annual operating cost method for modulating vented heaters would require substantial changes in order to properly consider the effects of oversizing. The changes would require additional calculations for the weighted-average efficiency because the fraction of time that the heater would operate in each mode would depend on the extent of oversizing and on the ratio of minimum to maximum heat output rates. The changes would be similar to today's amendments for modulating furnaces and boilers discussed above.

The variable annual operating cost method was originally developed for vented heaters under the premise that the cost data would be required for the FTC labeling program. The FTC has excluded vented heaters from the labeling program. Therefore, DOE sees no need to expand the estimated annual operating cost calculations for vented heaters.

DOE believes that for vented and unvented heaters the best economic measure to assist consumers in their purchasing decisions is the estimated operating cost per million Btu output. For vented heaters, the estimated cost is determined by using the measured output, the representative unit cost of energy and the annual fuel utilization efficiency (which may be determined from the simplified test procedure proposed today). For unvented heaters, the estimated cost is determined by using the measured output, the representative unit cost of energy and the implied efficiency of 100 percent.

At the public hearing, GAMA and Kerosun, Inc. expressed support for the cost per million Btu's measure. No comments opposing the measure were received. See GAMA, June 29; Kerosun, June 29. Therefore, DOE is today

prescribing this measure for both unvented and vented home heating equipment.

However, GAMA thought it appropriate that in addition to cost per million Btu's, an hourly operating cost be included for vented heaters as is currently included in electric unvented heaters. DOE sees little merit in such a measure for vented heaters since most vented heaters have modulating type controls and, therefore, various hourly operating costs. Accordingly, a consumer could be misled by this measure if comparisons are made across various firing rates. DOE feels that such comparisons should be avoided and is, therefore, not including them in today's regulations for all types of heaters.

A number of commenters pointed out an apparent deficiency in the measures provided for vented heaters. Although a regulation to determine the operating cost for heaters which use both fossil fuel and electricity was proposed for unvented heaters, no such regulation was proposed for vented heaters. This was an oversight on DOE's part and consequently, today's rule includes a regulation to determine operating cost for such heaters in both the unvented and vented heater subparagraphs.

#### E. Miscellaneous

After careful consideration of all of the comments and further consultation with NBS, DOE has made some editorial and minor technical changes to the published proposal in today's final rule. For instance, an equals sign (=) is added to the first expression in section 4.9 of Appendix N.

### III. PROCEDURAL MATTERS

#### A. Environmental Review

Pursuant to Section 7(c)(2) of the Federal Energy Administration Act of 1974, a copy of the proposed notice was submitted to the Administrator of the Environmental Protection Agency (EPA) for his comments concerning the impact of this proposal on the quality of the environment. EPA responded by letter with no comment on September 28, 1983.

In addition, the Department has reviewed today's final rule in accordance with the National Environmental Policy Act of 1969 (NEPA) (42 U.S.C. 4321 et seq.), the Council of Environmental Quality Regulations implementing the procedural provisions of NEPA (40 CFR Part 1500 et seq.), and the Department's own NEPA guidelines (45 FR 20694, March 28, 1980, as amended by 47 FR 7976, Feb. 23, 1982) to determine if an environmental impact statement (EIS) or

an environmental assessment (EA) is required.

Today's final rule serves only to standardize the measurement of energy usage for furnaces and other home heating equipment. The action of prescribing these revised test procedures will not result in any environmental impacts. Because it is clear that today's final rule is not a major Federal action significantly affecting the quality of the human environment within the meaning of NEPA, DOE has determined that neither an EA nor an EIA is required.

#### B. Regulatory Impact Review

The final rule has been reviewed in accordance with Executive Order 12291 which directs that all regulations achieve their intended goals without imposing unnecessary burdens on the economy, on individuals, on public or private organizations, or State and local governments. The Executive Order also requires that regulatory impact analyses be prepared for "major rules." The Executive Order defines a major rule as any regulation that is likely to result in: (1) An annual effect on the economy of \$100 million or more; (2) a major increase in costs or prices for consumers, individual industries, Federal, State, or local government agencies, or geographic regions; or (3) significant adverse effects on competition, employment, investment, productivity, innovation, or on the ability of the United States-based enterprises to compete with foreign-based enterprises in domestic or export markets.

This final rule would only make minor changes in the test procedures for furnaces and other home heating equipment. Therefore, DOE has determined that this final rule does not come within the definition of a major rule.

In accordance with Section 3(c)(3) of the Executive Order, which applies to rules other than major rules, the final rule was submitted to OMB for review without a regulatory impact analysis. This rule has been reviewed by OMB in accordance with the procedures applicable to rules other than major rules.

#### C. Small Entity Review

The Regulatory Flexibility Act (Pub. L. 96-354) requires that an agency prepare a final regulatory analysis to be available at the time the final rule is published. This requirement does not apply if the agency "certifies that the final rule will not \* \* \* have a



significant economic impact on a substantial number of small entities."

In the June 17 proposal, DOE certified, pursuant to Section 605(b) of the Regulatory Flexibility Act, that the proposal, if promulgated, would not have a significant economic impact on a substantial number of small entities. All commenters were generally supportive of the proposal and no commenter took issue with DOE's certification. Accordingly, DOE certifies that this rule will not have a significant economic impact on a substantial number of small entities.

#### List of Subjects in 10 CFR Part 430

Administrative practice and procedure, Energy conservation, Household appliances.

(Energy Policy and Conservation Act of December 22, 1975, Pub. L. 94-163, Sec. 323(a))

Issued in Washington, D.C., March 7, 1984.

Pat Collins,

Acting Assistant Secretary, Conservation and Renewable Energy.

#### PART 430—ENERGY CONSERVATION PROGRAM FOR CONSUMER PRODUCTS

Provisions of 10 CFR Part 430, § 430.2, § 430.22, Appendix G, Appendix N, and Appendix O are amended as follows:

1. Section 430.2 definition of "unvented home heating equipment" is revised and definitions of "Kerosene," "Unvented gas heater," and "unvented oil heater" are added in alphabetical order to read as follows:

##### § 430.2 Definition.

"Kerosene" means No. 1 fuel oil with a viscosity meeting the specifications as specified in UL-730-1974, section 36.9 and in tables 2 and 3 of ANSI Standard Z91.1-1972.

"Unvented gas heater" means an unvented, self-contained, free-standing, nonrecessed gas-burning appliance which furnishes warm air by gravity or fan circulation.

"Unvented home heating equipment" means a class of home heating equipment, not including furnaces, used for the purpose of furnishing heat to a space proximate to such heater directly from the heater and without duct connections and includes electric heaters and unvented gas and oil heaters.

"Unvented oil heater" means an unvented, self-contained, free-standing, nonrecessed oil-burning appliance

which furnishes warm air by gravity or fan circulation.

##### § 430.22 [Amended]

2. Section 430.22 is amended by revising paragraphs (g), (n) and (o) to read as follows:

##### (g) Unvented home heating equipment.

(1) The estimated annual operating cost for primary electric heaters, shall be the product of: (i) The average annual electric energy consumption in kilowatt-hours per year, determined according to section 3.1 of Appendix G of this subpart and (ii) the representative average unit cost in dollars per kilowatt-hour as provided pursuant to section 323(b)(2) of the Act, the resulting product then being rounded off to the nearest dollar per year.

(2) The estimated regional annual operating cost for primary electric heaters, shall be the product of: (i) The regional annual electric energy consumption in kilowatt-hours per year for primary heaters determined according to section 3.2 of Appendix G of this subpart and (ii) the representative average unit cost in dollars per kilowatt-hour as provided pursuant to section 323(b)(2) of the Act, the resulting product then being rounded off to the nearest dollar per year.

(3) The estimated operating cost per million Btu output shall be—

(i) For primary and supplementary electric heaters and unvented gas and oil heaters without an auxiliary electric system, the product of: (A) One million; and (B) the representative unit cost in dollars per Btu for natural gas, propane, or oil, as provided pursuant to section 323(b)(2) of the Act as appropriate, or the quotient of the representative unit cost in dollars per kilowatt-hour, as provided pursuant to section 323(b)(2) of the Act, divided by 3,412 Btu per kilowatt hour, the resulting product then being rounded off to the nearest 0.01 dollar per million Btu output; and

(ii) For unvented gas and oil heaters with an auxiliary electric system, the product of: (A) The quotient of one million divided by the rated output in Btu's per hour as determined in 3.4 of appendix G of this subpart; and (B) the sum of: (1) The product of the maximum fuel input in Btu's per hour as determined in 2.2. of this appendix times the representative unit cost in dollars per Btu for natural gas, propane, or oil, as appropriate, as provided pursuant to section 323(b)(2) of the Act, plus (2) the product of the maximum auxiliary electric power in kilowatts as determined in 2.1 of appendix G of this

subpart times the representative unit cost in dollars per kilowatt-hour as provided pursuant to section 323(b)(2) of the Act, the resulting quantity shall be rounded off to the nearest 0.01 dollar per million Btu output.

(4) The rated output for unvented heaters is the rated output as determined according to either sections 3.3 or 3.4 of Appendix G of this subpart, as appropriate, with the result being rounded to the nearest 100 Btu per hour.

(5) Other useful measures of energy consumption for unvented home heating equipment shall be those measures of energy consumption for unvented home heating equipment which the Secretary determines are likely to assist consumers in making purchasing decisions and which are derived from the application of Appendix G of this subpart.

(n) *Furnaces.* (1) The estimated annual operating cost for furnaces is the sum of: (i) The product of the average annual fuel energy consumption, in Btu's per year for gas or oil furnaces or in kilowatt-hours per year for electric furnaces, determined according to section 4.8 or 4.10 of Appendix N of this subpart, respectively, and the representative average unit cost in dollars per Btu for gas or oil, or dollars per kilowatt-hour for electric, as appropriate, as provided pursuant to section 323(b)(2) of the Act, plus (ii) the product of the average annual auxiliary electric energy consumption in kilowatt-hours per year determined according to section 4.9 of Appendix N of this subpart, and the representative average unit cost in dollars per kilowatt-hour as provided pursuant to section 323(b)(2) of the Act, the resulting sum then being rounded off to the nearest dollar per year. (For furnaces which operate with variable inputs, an estimated annual operating cost is to be calculated for each degree of oversizing specified in section 4 of Appendix N of this subpart.)

(2) The annual fuel utilization efficiency for furnaces, expressed in percent, is the ratio of annual fuel output of useful energy delivered to the heated space to the annual fuel energy input to the furnace determined according to section 4.6 of Appendix N of this subpart for gas and oil furnaces and determined in accordance with section 4.1 of Appendix N of this subpart for electric furnaces.

(3) The estimated regional annual operating cost for furnaces is the sum of: (i) The product of the regional annual fuel energy consumption in Btu's per year for gas or oil furnaces or in kilowatt-hours per year for electric



furnaces, determined according to section 4.11 or 4.13 of Appendix N of this subpart, respectively, and the representative average unit cost in dollars per Btu for gas or oil, or dollars per kilowatt-hour for electric, as appropriate, as provided pursuant to section 323(b)(2) of the Act, plus (ii) the product of the regional annual auxiliary electrical energy consumption in kilowatt-hours per year, determined according to section 4.12 of Appendix N of this subpart, and the representative average unit cost in dollars per kilowatt-hour as provided pursuant to section 323(b)(2) of the Act, the resulting sum then being rounded off to the nearest dollar per year.

(4) The energy factor for furnaces, expressed in percent, is the ratio of annual fuel output of useful energy delivered to the heated space to the total annual energy input to the furnace determined according to section 4.14 of Appendix N of this subpart.

(5) Other useful measures of energy consumption for furnaces shall be those measures of energy consumption which the Secretary determines are likely to assist consumers in making purchasing decisions and which are derived from the application of Appendix N of this subpart.

(o) *Vented home heating equipment.*

(1) The annual fuel utilization efficiency for vented home heating equipment, expressed in percent, which is the ratio of the annual fuel output of useful energy delivered to the heated space to the annual fuel energy input to the vented heater, shall be determined either according to section 4.1.17 of Appendix O of this subpart for vented heaters without either manual controls or thermal stack dampers; according to section 4.2.6 of Appendix O of this subpart for vented heaters equipped with manual controls; or according to section 4.3.7 of Appendix O of this subpart for vented heaters equipped with thermal stack dampers.

(2) The estimated operating cost per million Btu output for vented heaters without an auxiliary electric system shall be the product of: (i) One hundred; (ii) the quotient of one million Btu output divided by the annual fuel utilization efficiency as determined in paragraph (o) (1) and (iii) the representative unit cost in dollars per Btu for natural gas, propane, or oil, as appropriate, as provided pursuant to section 323(b)(2) of the Act, the resulting product shall be rounded to the nearest 0.01 dollar per million Btu output.

(3) The estimated operating cost per million Btu output for gas or oil vented home heating equipment with an auxiliary electric system shall be the

product of: (A) The quotient of one million Btu divided by the sum of: (1) The product of the maximum fuel input in Btu's per hour as determined in 3.1.1 or 3.1.2 of Appendix O of this subpart times the annual fuel utilization efficiency in percent as determined in 4.1.17, 4.2.6, or 4.3.7 of this appendix as appropriate divided by 100, plus (2) the product of the maximum electric power in watts as determined in 3.1.3 of Appendix O of this subpart times the quantity 3.412; and (B) of the sum of: (1) the product of the maximum fuel input in Btu's per hour as determined in 3.1.1 of this appendix times the representative unit cost in dollars per Btu for natural gas, propane, or oil, as appropriate, as provided pursuant to section 323(b)(2) of the Act; plus (2) the product of the maximum auxiliary electric power in kilowatts as determined in 3.1.3 of Appendix O of this subpart times the representative unit cost in dollars per kilowatt-hour as provided pursuant to section 323(b)(2) of the Act, the resulting quantity shall be rounded off to the nearest 0.01 dollar per million Btu output.

(4) Other useful measures of energy consumption for vented home heating equipment shall be those measures of energy consumption which the Secretary determines are likely to assist consumers in making purchasing decisions and which are derived from the application of Appendix O of this subpart.

3. Appendix G. to Subpart B of Part 430 is revised to read as follows:

**Appendix G to Subpart B of Part 430—Uniform Test Method for Measuring the Energy Consumption of Unvented Home Heating Equipment**

1. *Testing conditions.*

1.1 *Installation.*

1.1.1 *Electric heater.* Install heater according to manufacturer's instructions. Heaters shall be connected to an electrical supply circuit of nameplate voltage with a wattmeter installed in the circuit. The wattmeter shall have a maximum error not greater than one percent.

1.1.2 *Unvented gas heater.* Install heater according to manufacturer's instructions. Heaters shall be connected to a gas supply line with a gas displacement meter installed between the supply line and the heater according to manufacturer's specifications. The gas displacement meter shall have a maximum error not greater than one percent. Gas heaters with electrical auxiliaries shall be connected to an electrical supply circuit of nameplate voltage with a wattmeter installed in the circuit. The wattmeter shall have a maximum error not greater than one percent.

1.1.3 *Unvented oil heater.* Install heater according to manufacturer's instructions. Oil heaters with electric auxiliaries shall be connected to an electrical supply circuit of nameplate voltage with a wattmeter installed

in the circuit. The wattmeter shall have a maximum error not greater than one percent.

1.2 *Temperature regulating controls.* All temperature regulating controls shall be shorted out of the circuit or adjusted so that they will not operate during the test period.

1.3 *Fan controls.* All fan controls shall be set at the highest fan speed setting.

1.4 *Energy supply.*

1.4.1 *Electrical supply.* Supply power to the heater within one percent of the nameplate voltage.

1.4.2 *Natural gas supply.* For an unvented gas heater utilizing natural gas, maintain the gas supply to the heater with a normal inlet test pressure immediately ahead of all controls at 7 to 10 inches of water column. The regulator outlet pressure at normal supply test pressure shall be approximately that recommended by the manufacturer. The natural gas supplied should have a higher heating value within  $\pm 5$  percent of 1,025 Btu's per standard cubic foot. Determine the higher heating value, in Btu's per standard cubic foot, for the natural gas to be used in the test, with an error no greater than one percent. Alternatively, the test can be conducted using "bottled" natural gas of a higher heating value within  $\pm 5$  percent of 1,025 Btu's per standard cubic foot as long as the actual higher heating value of the bottled natural gas has been determined with an error no greater than one percent as certified by the supplier.

1.4.3 *Propane gas supply.* For an unvented gas heater utilizing propane, maintain the gas supply to the heater with a normal inlet test pressure immediately ahead of all controls at 11 to 13 inches of water column. The regulator outlet pressure at normal supply test pressure shall be that recommended by the manufacturer. The propane supplied should have a higher heating value of within  $\pm 5$  percent of 2,500 Btu's per standard cubic foot. Determine the higher heating value in Btu's per standard cubic foot, for the propane to be used in the test, with an error no greater than one percent. Alternatively, the test can be conducted using "bottled" propane of a higher heating value within  $\pm 5$  percent of 2,500 Btu's per standard cubic foot as long as the actual higher heating value of the bottled propane has been determined with an error no greater than one percent as certified by the supplier.

1.4.4 *Oil supply.* For an unvented oil heater utilizing kerosene, determine the higher heating value in Btu's per gallon with an error no greater than one percent. Alternatively, the test can be conducted using a tested fuel of a higher heating value within  $\pm 5$  percent of 137,400 Btu's per gallon as long as the actual higher heating value of the tested fuel has been determined with an error no greater than one percent as certified by the supplier.

1.5 *Energy flow instrumentation.* Install one or more energy flow instruments which measure, as appropriate and with an error no greater than one percent, the quantity of electrical energy, natural gas, propane gas, or oil supplied to the heater.

2. *Testing and measurements.*

2.1 *Electric power measurement.*

Establish the test conditions set forth in



section 1 of this appendix. Allow an electric heater to warm up for at least five minutes before recording the maximum electric power measurement from the wattmeter. Record the maximum electric power ( $P_E$ ) expressed in kilowatts.

Allow the auxiliary electrical system of a forced air unvented gas, propane, or oil heater to operate for at least five minutes before recording the maximum auxiliary electric power measurement from the wattmeter. Record the maximum auxiliary electric power ( $P_A$ ) expressed in kilowatts.

**2.2 Natural gas, propane, and oil measurement.** Establish the test conditions as set forth in section 1 of this appendix. A natural gas, propane, or oil heater shall be operated for one hour. Using either the nameplate rating or the energy flow instrumentation set forth in section 1.5 of this appendix and the fuel supply rating set forth in sections 1.4.2, 1.4.3, or 1.4.4 of this appendix, as appropriate, determine the maximum fuel input ( $P_F$ ) of the heater under test in Btu's per hour. The energy flow instrumentation shall measure the maximum fuel input with an error no greater than one percent.

### 3. Calculations.

**3.1 Annual energy consumption for primary electric heaters.** For primary electric heaters, calculate the annual energy consumption ( $E_E$ ) expressed in kilowatt-hours per year and defined as:

$$E_E = 2080(0.77)DHR$$

where:

2080 = national average annual heating load hours

0.77 = adjustment factor

DHR = design heating requirement and is equal to  $P_E / 1.2$  in kilowatts.

$P_E$  = as defined in 2.1 of this appendix

1.2 = typical oversizing factor for primary electric heaters

**3.2 Annual energy consumption for primary electric heaters by geographic region of the United States.** For primary electric heaters, calculate the annual energy consumption by geographic region of the United States ( $E_R$ ) expressed in kilowatt-hours per year and defined as:

$$E_R = HLH(0.77)(DHR)$$

where:

HLH = heating load hours for a specific region determined from Figure 1 of this appendix in hours

0.77 = as defined in 3.1 of this appendix  
DHR = as defined in 3.1 of this appendix

**3.3 Rated output for electric heaters.** Calculate the rated output ( $Q_{out}$ ) for electric heaters, expressed in Btu's per hour, and defined as:

$$Q_{out} = P_E (3,412 \text{ Btu/kWh})$$

where:

$P_E$  = as defined in 2.1 of this appendix

**3.4 Rated output for unvented heaters using either natural gas, propane, or oil.** For unvented heaters using either natural gas, propane, or oil equipped without auxiliary electrical systems, the rated output ( $Q_{out}$ ), expressed in Btu's per hour, is equal to  $P_F$ , as determined in section 2.2 of this appendix.

For unvented heaters using either natural gas, propane, or oil equipped with auxiliary electrical systems, calculate the rated output ( $Q_{out}$ ), expressed in Btu's per hour, and defined as:

$$Q_{out} = P_F + P_A (3,412 \text{ Btu/kWh})$$

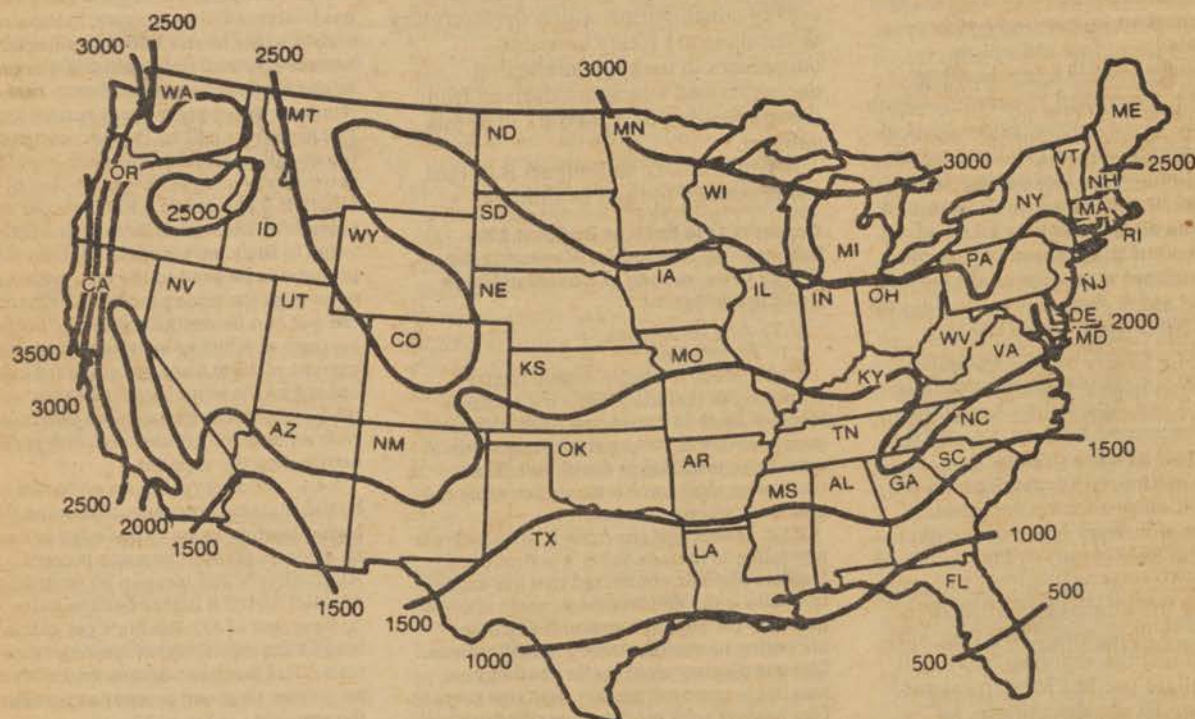
where:

$P_F$  = as defined in 2.2 of this appendix in Btu/hr

$P_A$  = as defined in 2.1 of this appendix in Btu/hr

## FIGURE 1

Heating Load Hours (HLH) for the United States and Territories



This map is reasonably accurate for most parts of the United States but is necessarily highly generalized and consequently not too accurate in mountainous regions, particularly in the Rockies.

Alaska — 3500 HLH  
Hawaii and Territories — 0 HLH



4. Appendix N to Subpart B of Part 430 is revised to read as follows:

**Appendix N to Subpart B of Part 430—  
Uniform Test Method for Measuring the  
Energy Consumption of Furnaces**

1. *Definitions.* Definitions shall include the definitions specified in section 3.0 of ANSI/ASHRAE 103-82 and the following additional definitions:

1.1 "ASHRAE" means the American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.

1.2 "ANSI/ASHRAE 103-82" means the test standard published in 1982 by ASHRAE, approved by the American National Standards Institute (ANSI) on June 21, 1983 and titled "Methods of Testing for Heating Seasonal Efficiency of Central Furnaces And Boilers."

1.3 "Electro-mechanical stack damper" means a type of stack damper which is operated by electrical and/or mechanical means.

1.4 "Isolated combustion system" means an installation in which a furnace is installed indoors and all combustion and ventilation air is admitted through grills or ducts from outdoors and (all such air) does not communicate with air in the conditioned space.

1.5 "Modulating control" means either a step modulating or a "two-stage control"

1.6 "Reduced heat input rate" means the factory adjusted lowest reduced heat input rate for furnaces equipped with either two stage thermostats or step-modulating thermostats.

1.7 "Single stage thermostat" means a thermostat that cycles a burner from the maximum heat input rate and off.

1.8 "Step-modulating control" means a modulating control that cycles a burner from the reduced input rate to off if the heating load is light. If a higher heating load is encountered which cannot be met with the reduced input rate, the control either gradually increases or steps up the input rate to meet the higher heating load. At that point if a lower heating load is encountered, the control either gradually decreases or steps down to a lower rate, or gradually increases the heat input to meet any higher heating load that cannot be met with the low firing rate.

1.9 "Thermal stack damper" means a type of stack damper which is dependent for operation exclusively upon the direct conversion of thermal energy of the stack gases into closure of the damper.

1.10 "Two stage control" means a modulating control that cycles a burner from reduced heat input rate and off or cycles a burner at the maximum heat input rate and off.

2.0 *Testing conditions.* The testing conditions shall be as specified in section 8 of ANSI/ASHRAE 103-82 with the exception of section 8.4.2.3, and the inclusion of the following additional testing conditions:

2.1 *Gas burner adjustment at maximum input rate.* The following paragraph is in addition to the requirements specified in section 8.4.1.1 of ANSI/ASHRAE 103-82:

For gas fueled furnaces and boilers equipped with modulating type controls,

adjust the controls to operate the unit at the maximum fuel input rate. Set the thermostat control to the maximum setting. Start the furnace or boiler by turning the safety control valve to the "on" position. Use a supply water temperature for boilers that will allow for continuous operation without shut off by the thermostat control.

2.2 *Gas burner adjustment at reduced input rate.* The following paragraph is in addition to the requirements specified in section 8.4.1.1 of ANSI/ASHRAE 103-82:

For gas fueled furnaces and boilers equipped with modulating type thermostat controls, adjust the controls to operate the unit at the reduced fuel input rate. Set the thermostat control to the lowest setting that does not cause the burner to cycle on and off. Start the furnace or boiler by turning the safety control valve to the "on" position. Use supply water temperature for boilers that will allow for continuous operation without shut off by the thermostat control. If necessary, supply water may be increased above 120° F in order to maintain continuous operation at the reduced setting.

2.3 *Gas and oil fueled low pressure steam and hot water boilers (including direct vent systems).* The following paragraphs are in place of section 8.4.2.3 of ANSI/ASHRAE 103-82:

For non-condensing hot water boilers, the water flow rate shall be adjusted to produce a water temperature rise, during the steady-state test described in section 9.1 of ANSI/ASHRAE 103-82, of 19° F–24° F. During the steady-state and heat-up tests, the hot water boiler shall be supplied with water having a temperature of at least 120° F but not more than 124° F.

For steam boilers, the pressure shall be at atmospheric or at a pressure not exceeding 2 psig during the steady-state test.

3.0 *Test procedure.* Testing and measurements shall be as specified in section 9 of ANSI/ASHRAE 103-82 with the exception of sections 9.2.2 and 9.3.2, and the inclusion of the following additional procedures:

3.1 *Gas fueled gravity furnaces, forced air central furnaces, and low pressure steam and hot water boilers (including direct vent systems, excluding condensing furnaces or boilers).* The following paragraphs are in addition to the requirements specified in section 9.1.1 of ANSI/ASHRAE 103-82:

For all gas fueled furnaces and boilers, the steady-state efficiency shall be determined at the maximum fuel input rate measured in accordance with sections 2.1 of this appendix and section 9.1.1 of ANSI/ASHRAE 103-82. Also, for gas fueled furnaces and boilers equipped with either two stage thermostats or step-modulating thermostats, the steady-state efficiency shall also be determined at the reduced fuel input rate measured in accordance with sections 2.2 of this appendix and section 9.1.1 of ANSI/ASHRAE 103-82.

In addition, for gas fueled furnaces and boilers equipped with draft hoods, measure CO<sub>2</sub> in stack after dilution during the steady state condition.

3.2 *Flue temperature measurements—cool down test.* The following paragraphs are in addition to the requirements specified in section 9.2 of ANSI/ASHRAE 103-82:

For furnaces and boilers equipped with step-modulating thermostats, the cool down test shall be conducted after steady-state conditions have been reached at the reduced input rate, as specified in section 2.2 of this appendix. For furnaces and boilers equipped with two stage controls, separate cool down tests shall be conducted after steady-state conditions have been reached at both the reduced and maximum fuel input rates.

3.3 *Gas and oil fueled boilers—cool down test.* The following paragraphs are in place of the requirements specified in section 9.2.2 of ANSI/ASHRAE 103-82:

After steady-state testing has been completed, turn the main burner(s) off and measure the flue gas temperature at 3.75 (T<sub>F,OFF(3)</sub>) and 22.5 (T<sub>F,OFF(4)</sub>) minutes after the burner shuts off, using the thermocouple grid described above. During this off period for units that do not have pump delay after shut-off, no water shall be allowed to circulate through the hot water boilers. For units that have pump delay on shut-off, except those having pump controls sensing water temperature, the pump shall be stopped by the unit control and the time, t', between burner shut-off and pump shut-off shall be measured within one second accuracy. For units having pump delay controls which sense water temperature, the pump shall be operated for 15 minutes and t' shall be 15 minutes. While the pump is operating, the inlet water temperature and flow rate shall be maintained at the same values as used during the preceding steady-state test.

Make a third flue gas temperature measurement 45 minutes after the burner shuts off to determine the off-period minimum flue gas temperature (T<sub>F,OFF(5)</sub>).

During this cool down test, measure the energy input rate to the pilot light (Q<sub>p</sub>), if the unit is so equipped, to within an error no larger than ± 3 percent. Record all measured values. For oil fueled units not equipped with stack dampers, maintain the draft in the flue within the same ranges specified in section 9.2.1 of ANSI/ASHRAE 103-82. For direct vent systems with flue dampers or boilers equipped with both stack dampers and barometric dampers, close the flue or stack damper during the cool down test.

3.4 *Flue gas temperature measurements—heat-up test.* The following paragraph is in addition to the requirement specified in section 9.3 of ANSI/ASHRAE 103-82.

For furnaces and boilers equipped with step-modulating thermostats, the heat-up test shall be conducted at the reduced fuel input rate, as specified in section 2.2 of this appendix. For furnaces and boilers equipped with two stage controls, separate heat-up tests shall be conducted at both the reduced and maximum fuel input rates.

3.5 *Gas and oil fueled boilers.* The following paragraph is in place of the requirements specified in section 9.3.2 of ANSI/ASHRAE 103-82.

Fifty minutes or more after the main burner(s) is turned off for the cool down test, turn on the steam or hot water boiler and measure the flue gas temperature at 1.0 (T<sub>L,ON(1)</sub>) and 5.5 (T<sub>L,ON(2)</sub>) minutes after the main burners are turned on. The pump circulating the water through the hot water



boiler shall be started simultaneously with the main burner(s). The water flow rate shall be the same as that maintained during the steady-state test described in section 9.1 of ANSI/ASHRAE 103-82. During the heat-up test for oil fired boilers maintain the draft in the flue pipe within  $\pm 0.01$  inch of water column of the manufacturer's recommended on-period draft. Record the measured temperatures.

### 3.6 Direct measurement of condensate.

For condensing furnaces and boilers, the condensate heat loss shall be determined either by the method specified in section 11.2.33 of ANSI/ASHRAE 103-82 or by the following test procedures:

Control devices shall be installed to allow cyclical operation of the unit and return water or air flows as described in sections 9.2 and 9.3 of ANSI/ASHRAE 103-82 and sections 3.2, 3.3, 3.4 and 3.5 of this appendix. The test unit shall be leveled prior to test. Operating times and beginning and end of condensate collection shall be determined by a clock or timer with a minimum resolution of one second. Humidity of the room air shall, at no time, exceed 80 percent.

Control of on or off operation actions shall be within  $\pm 6$  seconds of the scheduled time. Condensate drain lines shall be attached to the unit as specified in the manufacturer's installation instructions. A continuous downward slope of drain lines from the unit shall be maintained. Additional precautions shall be taken to facilitate uninterrupted flow of condensate during the test.

The flue pipe installation must not allow condensate formed in the flue pipe to flow back into the unit. An initial downward slope from the unit's exit, an offset with a drip leg, annular collection rings, or drain holes must be included in the flue pipe installation without disturbing normal flue gas flow, as specified in section 7.2.2 of ANSI/ASHRAE 103-82. Flue gases should not flow out of the drain with the condensate.

Collection-containers must be glass or polished stainless steel, so removal of interior deposits can be easily made. The collection-container shall have a vent opening to the atmosphere.

The scale for measuring the containers and sample condensate mass shall be calibrated with an error no larger than  $\pm 0.5$  percent over the range of interest.

The condensing furnace or boiler shall be tested by the flue loss method in accordance with the provisions for condensing units, as specified in section 9 of ANSI/ASHRAE 103-82 and section 3 of this appendix. The condensate collection-containers shall be dried prior to each use and shall be at room ambient temperature prior to a sample collection. Tare weight of the collection-container must be measured and recorded prior to each sample collection.

The unit should be operated in a cyclical manner until flue gas temperatures at the end of each on-cycle are within  $5^\circ\text{F}$  ( $2.8^\circ\text{C}$ ) of each other for two consecutive cycles. On-cycle and off-cycle times are listed in Table 2 of this appendix. Begin three test cycles. Return air temperature for furnaces shall be as specified in section 9 of ANSI/ASHRAE 103-82 and section 3 of this appendix. Return water temperature for boilers shall be as

specified in section 2.3 of this appendix. Operation of the furnace blower or boiler pump shall conform to the time delay requirements specified in sections 9.2 and 9.3 of ANSI/ASHRAE 103-82 and sections 3.2, 3.3, 3.4, and 3.5 of this appendix for cool down and heat up tests. Operation of the boiler pump shall conform to the time delay requirements specified in section 3.3 of this appendix.

Begin condensate collection at one minute before the on-cycle period of the first test cycle. The container shall be removed one minute before the end of each off-cycle period of the sixth test cycle. Condensate mass shall be measured for each test cycle.

Fuel input shall be recorded during the entire test period starting at the beginning of the on-time period of the first cycle to the beginning of the on-time period of the second cycle, etc., for each of the test cycles. Fuel higher heating value (HHV), temperature and pressures necessary for determining fuel energy input ( $Q_c$ ) shall be recorded. The fuel quantity and HHV shall be measured with errors no greater than one percent. Determine the mass of condensate for each cycle ( $m_c$ ) in pounds. If at the end of three cycles, the sample standard deviation is within 20% of the mean value for 3 cycles use total condensate collected in the three cycles as  $m_c$ ; if not, continue collection for an additional three cycles and use the total condensate collected for the six cycles as  $m_c$ . Determine the fuel energy input during the three or six test cycles ( $Q_c$ ) expressed in Btu.

Begin a steady-state condensate collection after steady-state conditions have been achieved as specified in section 8 of ANSI/ASHRAE 103-82 and section 2 of this appendix. The steady-state collection period shall be 30 minutes. Condensate mass shall be measured immediately at the end of the collection period to prevent evaporation loss from the sample. Fuel input shall be recorded for the one hour steady-state test period. Fuel Higher Heating Value (HHV), temperature and pressures necessary for determining fuel energy input  $Q_{c,ss}$  will be observed and recorded in Btu's. The fuel quantity and HHV shall be measured with errors no greater than one percent. Determine the mass of condensate for the steady-state test,  $m_{c,ss}$ , in pounds by subtracting the tare container weight from the total container and condensate weight measured at the end of the 30 minutes test period.

### 3.7 Direct measurement of off-cycle losses testing method. Reserved.

3.8 Direct measurement of the S/F factors for oil furnaces and boilers. For oil furnaces and boilers that are marketed and sold with attached barometric dampers, the S/F factor shall be determined either by using assigned factors in Table 2 of ANSI/ASHRAE 103-82 or by the following test procedure:

To directly measure the S/F factor, seal the barometric damper plate in the closed position. Operate the furnace or boiler until steady-state temperatures are attained. Adjust the draft in the flue within one foot of the heat exchanger exit to be between 0.075 and 0.085 inch water column. A mechanical draft inducer or a natural draft developed by adjusting the height of the test stack may be used. Remove the seal from the barometric

damper and adjust the damper gate to achieve proper draft, as specified by the manufacturer. If the draft over the fire is specified as a range, adjust the draft to the mid-point of that range.

After steady-state conditions are again achieved with the draft adjusted as specified, measure  $\text{CO}_2$  before and after dilution at points marked A and B in Figure 2 of this appendix. To ensure that the sample is well mixed after dilution obtain a representative sample of stack gas by sampling from several points on a horizontal plane through the cross section of the stack. The test setup shown in Figure 2 enhances the mixing of dilution air and flue gases. Alternatively, a straight length of stack or other flue piping arrangement may be used with stack samples taken sufficiently downstream after dilution in order to obtain a well-mixed sample.

3.9 Furnaces and boilers that includes small air passages in the flue. For furnaces and boilers that includes small air passages in the flue where such passage serves a utility other than for draft relief, the air passage shall be open during all tests and the test data shall be reduced as specified in section 4 of this appendix.

These units shall be considered as direct exhaust systems, for the purposes of this test procedure. These provisions shall not apply to systems which allow for air flow through the air passage in excess of 10 percent of maximum steady state total flue flow; in these cases, such passages are to be considered as draft diverters or draft hoods.

4.0 Calculations. Calculations shall be as specified in section 11 of ANSI/ASHRAE 103-82 with the exception of section 11.2.6, and the inclusion of the following additional calculations:

4.1 Annual fuel utilization efficiency for electric furnaces and boilers. The annual fuel utilization efficiency for electric furnaces and boilers (AFUE) is equal to the heating seasonal efficiency for electric furnaces and boilers ( $\text{Eff}_{h,se}$ ) as defined in section 11.1 of ANSI/ASHRAE 103-82.

4.2. Average ratio of stack gas mass flow rate to flue gas mass flow rate at steady-state operation. The following paragraphs are in place of the requirements specified in section 11.2.6 of ANSI/ASHRAE 103-82:

For gas furnaces and boilers with integral draft diverters, calculate the average ratio of stack gas mass flow rate to flue gas mass flow rate at steady-state operation (S/F) defined as:

$$S/F = 1.3 R_{T,s}/R_{T,f}$$

where:

$R_{T,s}$  = as defined in 11.2.3 of ANSI/ASHRAE 103-82

$R_{T,f}$  = as defined in 11.2.2 of ANSI/ASHRAE 103-82

For gas furnaces and boilers equipped with draft hoods determine the S/F by the method set out above or use the assigned value of 2.4. This alternative method may be used until 24 months from the effective date of the amendment. After that date, the assigned value may not be used and only the method set out above may be used.

For oil furnaces and boilers, S/F shall be 1.40 for units not shipped with barometric



dampers or for units shipped with barometric dampers, S/F shall be either 1.40 or determined by:

$$S/F = R_{T,S}/R_{T,F}$$

where:

$R_{T,S}$  = as defined in 11.2.3 of ANSI/ASHRAE 103-82 in which the value of  $CO_2$  measured in the stack in 3.8 of this appendix is used

$R_{T,F}$  = as defined in 11.2.2 of ANSI/ASHRAE 103-82 in which the value of  $CO_2$  measured in the flue in 3.8 of this appendix is used

**4.3 Optional direct condensate measurement method.** For condensing furnaces and boilers for which the direct measurement of condensate is used, as specified in section 3.6 of this appendix, calculate the part-load efficiency ( $\eta_p$ ) and the steady-state efficiency ( $\eta_{ss}$ ) expressed as a percent and defined as:

$$\eta_p = \text{Effy}_{hs} + L_G - L_C$$

$$\eta_{ss} = \text{Effy}_{ss} + L_{G,ss} - L_{C,ss}$$

where:

$\text{Effy}_{hs}$  = heating seasonal efficiency for non-condensing furnaces and boilers, as defined in 11.2.34 of ANSI/ASHRAE 103-82

$L_G$  = latent heat gain under part-load conditions, as defined in 4.3.1 of this appendix

$L_C$  = part-load heat loss due to the condensate going down the drain and corrected for the fact that the condensate did not go up the flue as heated vapor, as was assumed in determining  $L_{G,ss,A}$ , as defined in 4.3.2 of this appendix

$\text{Effy}_{ss}$  = steady-state efficiency for non-condensing furnaces and boilers, as defined in 11.2.5 of ANSI/ASHRAE 103-82

$L_{G,ss}$  = latent heat gain under steady-state conditions, as defined in 4.3.3 of this appendix

$L_{C,ss}$  = steady-state heat loss due to the condensate going down the drain and corrected for the fact that the condensate did not go up the flue as heated vapor, as was assumed in determining  $L_{G,ss,A}$ , as defined in 4.3.4 of this appendix

**4.3.1 Latent heat gain under part-load conditions.** Calculate the latent heat gain under part-load conditions ( $L_G$ ) expressed as a percent and defined as:

$$L_G = 100(1053.3) m_c / Q_c$$

where:

100 = conversion factor to express a decimal as a percent

1053.3 = latent heat vaporization of water, Btu per pound

$m_c$  = as defined in 3.6 of this appendix

$Q_c$  = as defined in 3.6 of this appendix

**4.3.2 Part-load heat loss due to the condensate.** Calculate the part-load heat loss due to the condensate going down the drain and corrected for the fact that the condensate did not go up the flue as heated vapor, as was assumed in determining  $L_{G,ss,A}$  ( $L_C$ ) expressed as a percent and defined as:

$$L_C = L_G [1.0(T_{F,ss} - 70) - 0.45(T_{F,ss} - 42)] / 1053.3$$

where:

$L_G$  = as defined in 4.3.1 of this appendix

1.0 = specific heat of water (liquid), Btu per pound - °F

$T_{F,ss}$  = as defined in 11.2.4 of ANSI/ASHRAE 103-82

70 = assumed average indoor air temperature, °F

0.45 = specific heat of water vapor, Btu per pound - °F

42 = average outdoor temperature corresponding to 5,200 degree day location, °F

1053.3 = latent heat of vaporization of water, Btu per pound

**4.3.3 Latent heat gain under steady-state conditions.** Calculate the latent heat gain under steady-state conditions ( $L_{G,ss}$ ) expressed as a percent and defined as:

$$L_{G,ss} = 100(1053.3) m_{c,ss} / Q_{c,ss}$$

where:

100 = conversion factor to express a decimal as a percent

1053.3 = latent heat of vaporization of water, Btu per pound

$m_{c,ss}$  = as defined in 3.6 of this appendix, pound

$Q_{c,ss}$  = as defined in 3.6 of this appendix, Btu

**4.3.4 Steady-state heat loss due to the condensate.** Calculate the steady-state heat loss due to the condensate going down the drain ( $L_{C,ss}$ ) expressed as a percent and defined as:

$$L_{C,ss} = L_{G,ss} [1.0(T_{F,ss} - 70) - 0.45(T_{F,ss} - 42)] / 1053.3$$

where:

$L_{G,ss}$  = as defined in 4.3.3 of this appendix

1.0 = specific heat of water (liquid), Btu per pound - °F

$T_{F,ss}$  = as defined in 11.2.4 of ANSI/ASHRAE 103-82

70 = assumed average indoor air temperature, °F

0.45 = specific heat of water vapor, Btu per pound - °F

42 = average outdoor temperature corresponding to 5200 degree day location, °F

1053.3 = latent heat of vaporization of water, Btu per pound

**4.4 Direct determination of off-cycle losses for furnaces and boilers equipped with stack dampers.** Reserved

**4.5 Modulating controls.**

**4.5.1 Weighted-average part-load utilization efficiency.** For furnaces and boilers equipped with two stage thermostats, calculate the weighted-average part-load utilization efficiency at each design heating requirement ( $\eta_{U,WT}$ ) expressed as a percent and defined as:

$$\eta_{U,WT} = X_1 \eta_{U,RED} + X_2 \eta_{U,MAX}$$

where:

$X_1$  = fraction of heating load at reduced operating mode, as defined in 4.5.2 of this appendix

$\eta_{U,RED}$  = the part-load efficiency at the reduced fuel input rate and is defined as the heating seasonal efficiency ( $\text{Effy}_{hs}$ ) in 11.2.34 of ANSI/ASHRAE 103-82, measured at the reduced fuel input rate and calculated by using the appropriate on and off times as specified from Table 2 of this appendix

$X_2$  = fraction of heating load at maximum operating mode, as defined in 4.5.3 of this appendix

$\eta_{U,MAX}$  = the part-load efficiency at the maximum fuel input rate and is defined as the heating seasonal efficiency ( $\text{Effy}_{hs}$ ) in 11.2.34 of ANSI/ASHRAE 103-82, measured at the maximum fuel input rate and calculated by using the appropriate on and off times as specified from Table 2 of this appendix

For furnaces and boilers equipped with step-modulating thermostats, calculate  $\eta_{U,WT}$  expressed as a percent and defined as:

$$\eta_{U,WT} = X_1 \eta_{U,RED} + X_2 \eta_{U,MOD}$$

where:

$X_1$  = as defined in 4.5.2 of this appendix

$\eta_{U,RED}$  = as defined in 4.5.1 of this appendix

$X_2$  = as defined in 4.5.3 of this appendix

$\eta_{U,MOD}$  = average part-load efficiency for the modulating mode, as defined in 4.5.8 of this appendix

**4.5.2 Fraction of heating load at reduced operating mode.** Determine the fraction of heating load at the reduced operating mode ( $X_1$ ) expressed as a decimal and listed in either Figure 4 or Table 3 of this appendix for appropriate values of the balance point temperature ( $T_C$ ).  $T_C$  is defined in section 4.5.4 of this appendix.

**4.5.3 Fraction of heating load at maximum operating mode.** Determine the fraction of heating load at the maximum operating mode ( $X_2$ ) expressed as a decimal and listed in either Figure 4 or Table 3 of this appendix for appropriate values of the balance point temperature ( $T_C$ ).

**4.5.4 Balance point temperature.** Calculate the balance point temperature ( $T_C$ ) which represents a temperature used to apportion the annual heating load between the reduced input cycling mode and either the modulation mode or maximum input cycling mode.  $T_C$  is defined as:

$$T_C = 65 - [\Delta T_D (1 + \alpha_{DHR}) (Q_{OUT,RED} / Q_{OUT,MAX})]$$

where:

65 = average outdoor temperature at which a furnace or boiler starts operating, °F

$\Delta T_D$  = the difference between the outdoor air temperature where heating is typically required and the outdoor design temperature, the national average temperature difference is 65° F - 5° F or 60° F

5 = outdoor design temperature

$\alpha_{DHR}$  = oversize factor at each design heating requirement, as defined in 4.5.5 of this appendix

$Q_{OUT,RED}$  = heat output rate at the reduced fuel input rate, as defined in 4.5.6 of this appendix

$Q_{OUT,MAX}$  = heat output rate at the maximum fuel input rate, as defined in 4.5.7 of this appendix

**4.5.5 Oversize factor at each design heating requirement.** Calculate the oversize factor at each design heating requirement ( $\alpha_{DHR}$ ) expressed as a decimal and defined as:

$$\alpha_{DHR} = [Q_{OUT,MAX} / DHR] - 1$$

where:

$Q_{OUT,MAX}$  = as defined in 4.5.7 of this appendix

DHR = typical design heating requirements, as listed in Table 1 of this appendix



4.5.6 *Heat output rate at the reduced fuel input rate.* Calculate the heat output rate at the reduced fuel input rate ( $Q_{OUT,RED}$ ) defined as:

$$Q_{OUT,RED} = \eta_{SS,RED} Q_{IN,RED}$$

where:

$\eta_{SS,RED}$  = steady-state efficiency at the reduced fuel input rate and is defined as the steady-state efficiency ( $\text{Eff}_{SS}$ ) in 11.2.5 of ANSI/ASHRAE 103-82, measured at the reduced fuel input rate  
 $Q_{IN,RED}$  = the reduced fuel input rate and is defined as  $Q_{IN}$  in 11.2.34 of ANSI/ASHRAE 103-82, measured at the reduced fuel input rate

4.5.7 *Heat output rate at the maximum fuel input rate.* Calculate the heat output rate at the maximum fuel input rate ( $Q_{OUT,MAX}$ ) defined as:

$$Q_{OUT,MAX} = \eta_{SS,MAX} Q_{IN,MAX}$$

where:

$\eta_{SS,MAX}$  = steady-state efficiency at the maximum fuel input rate and is defined as the steady-state efficiency ( $\text{Eff}_{SS}$ ) in 11.2.5 of ANSI/ASHRAE 103-82, measured at the maximum fuel input rate  
 $Q_{IN,MAX}$  = the maximum fuel input rate and is defined as  $Q_{IN}$  in 11.2.34 of ANSI/ASHRAE 103-82

4.5.8 *Average part-load efficiency for the modulating mode for furnaces and boilers equipped with step-modulating thermostats.*

$$\eta_{SS,MOD} = \left[ \frac{DHR - Q_{OUT,RED}}{Q_{OUT,MAX} - Q_{OUT,RED}} \right] \left[ \frac{T_C - T_{OA^*}}{T_C - 5} \right] \left[ \eta_{SS,MAX} - \eta_{SS,RED} \right] + \eta_{SS,RED}$$

where:

DHR = average design heating requirement as listed in Table 1 of this appendix  
 $Q_{OUT,RED}$  = as defined in 4.5.6 of this appendix  
 $Q_{OUT,MAX}$  = as defined in 4.5.7 of this appendix  
 $T_C$  = as defined in 4.5.4 of this appendix and is based on the average design heating requirement listed in Table 3 of this appendix

$T_{OA^*}$  = average outdoor air temperature during the modulating mode, as defined in 4.5.1 of this appendix and is based on the average design heating requirement listed in Table 3 of this appendix

5 = outdoor design temperature, °F

$\eta_{SS,MAX}$  = as defined in 4.5.7 of this appendix

$\eta_{SS,RED}$  = as defined in 4.5.6 of this appendix

4.5.10 *Average on-cycle infiltration heat loss for the modulating mode for furnaces and boilers equipped with step-modulating thermostats.* For furnaces and boilers equipped with step-modulating thermostats, calculate the average on-cycle infiltration heat loss for the modulating mode ( $L_{I,ON,MOD}$ ) expressed as a percent and defined as:

$$L_{I,ON,MOD} = [K_{I,ON,RED}(70 - T_{OA}) + K_{I,ON,MAX}(70 - T_{OA^*})] / 2$$

where:

$K_{I,ON,RED}$  = multiplication factor for infiltration loss during burner on-cycle at the reduced firing rate, and defined as  $K_{I,ON}$  in 11.2.18 of ANSI/ASHRAE 103-82 at the reduced firing rate  
 70 = average indoor temperature, °F

For furnaces and boilers equipped with step-modulating thermostats and are located in heated spaces, calculate the average part-load efficiency for the modulating mode ( $\eta_{U,MOD}$ ) expressed as a percent and defined as:

$$\eta_{U,MOD} = \eta_{SS,MOD} - L_{I,ON,MOD}$$

where:

$\eta_{SS,MOD}$  = average steady-state efficiency for the modulating mode as defined in 4.5.9 of this appendix

$L_{I,ON,MOD}$  = average on-cycle infiltration heat loss for the modulating mode as defined in 4.5.10 of this appendix

For furnaces and boilers equipped with step-modulating thermostats and are located outside or are in unheated spaces, calculate  $\eta_{U,MOD}$  defined as:

$$\eta_{U,MOD} = \eta_{SS,MOD} - C_I L_I$$

where:

$\eta_{SS,MOD}$  = as defined in 4.5.9 of this appendix

$C_I$  = as defined in 4.6 of this appendix

$L_I$  = as defined in 4.6 of this appendix

4.5.9 *Average steady-state efficiency for the modulating mode for furnaces and boilers equipped with step-modulating thermostats.* For furnaces and boilers equipped with step-modulating thermostats, calculate the average steady-state efficiency for the modulating mode ( $\eta_{SS,MOD}$ ) expressed as a percent and defined as:

$T_{OA}$  = average outdoor temperature in the cycling mode, based on the average design heating requirement, and is listed in either Figure 3 or Table 2 of this appendix

$K_{I,ON,MAX}$  = multiplication factor for infiltration loss during burner on-cycle at the maximum firing rate, and defined as  $K_{I,ON}$  in 11.2.18 of ANSI/ASHRAE 103-82 at the maximum firing rate

$T_{OA^*}$  = average outdoor temperature in the modulating mode, based on the average design heating requirement, and is listed in either Figure 3 or Table 3 of this appendix

4.5.11 *Average heat output rate for the modulating mode for furnaces and boilers equipped with step-modulating thermostats.* For furnaces and boilers equipped with step-modulating thermostats, calculate the average heat output rate for the modulating mode ( $Q_{OUT,MOD}$ ) defined as:

$$Q_{OUT,MOD} = [(DHR - Q_{OUT,RED}) / (T_C - 5)] + Q_{OUT,RED}$$

where:

DHR = average design heating requirement, as listed in Table 1 of this appendix

$Q_{OUT,RED}$  = as defined in 4.5.6 of this appendix

$T_C$  = as defined in 4.5.4 of this appendix and is based on the average design heating requirement listed in Table 3 of this appendix

$T_{OA^*}$  = as defined in 4.5.10 of this appendix and is based on the average design

heating requirement listed in Table 3 of this appendix

5 = outdoor design temperature, °F

4.5.12 *Average fuel input rate for the modulating mode for furnaces and boilers equipped with step-modulating thermostats.* For furnaces and boilers equipped with step-modulating thermostats, calculate the average fuel input rate for the modulating mode ( $Q_{IN,MOD}$ ) defined as:

$$Q_{IN,MOD} = Q_{OUT,MOD} / \eta_{SS,MOD}$$

where:

$Q_{OUT,MOD}$  = as defined in 4.5.11 of this appendix

$\eta_{SS,MOD}$  = as defined in 4.5.9 of this appendix

4.5.13 *Average outdoor temperature.* For furnaces and boilers equipped with two stage thermostats or with step-modulating thermostats operating at the reduced operating mode, the average outdoor temperature shall be  $T_{OA}$ , as obtained either from Figure 3 or Table 3 of this appendix. For furnaces and boilers equipped with two stage thermostats operating at the maximum operating mode or with step-modulating thermostats operating at the modulating mode, the average outdoor temperature shall be  $T_{OA^*}$ , as obtained from either Figure 3 or Table 3 of this appendix. These values for the average outdoor temperature shall replace the value of 42 specified as the average outdoor temperature in sections 11.2.15, 11.2.17, 11.2.19, 11.2.30, 11.2.31, and 11.2.33 of ANSI/ASHRAE 103-82.

4.5.14 *Weighted-average steady-state efficiency.* For furnaces and boilers equipped with two stage thermostats, calculate the weighted-average steady-state efficiency ( $\eta_{SS,WT}$ ) expressed as a percent and defined as:

$$\eta_{SS,WT} = X_1 \eta_{SS,MAX} + X_2 \eta_{SS,RED}$$

where:

$X_1$  = as defined in 4.5.2 of this appendix

$\eta_{SS,MAX}$  = as defined in 4.5.7 of this appendix

$X_2$  = as defined in 4.5.3 of this appendix

$\eta_{SS,RED}$  = as defined in 4.5.6 of this appendix

For furnaces and boilers equipped with step-modulating thermostats, calculate  $\eta_{SS,WT}$  defined as:

$$\eta_{SS,WT} = X_2 \eta_{SS,MOD} + X_1 \eta_{SS,RED}$$

where:

$X_1$  = as defined in 4.5.2 of this appendix

$\eta_{SS,MOD}$  = as defined in 4.5.9 of this appendix

$X_2$  = as defined in 4.5.3 of this appendix

$\eta_{SS,RED}$  = as defined in 4.5.6 of this appendix

4.6 *Annual fuel utilization efficiency.* The annual fuel utilization efficiency (AFUE) shall be expressed as a percent and defined as:

$$AFUE = \frac{5200 \eta_{SS} \eta_U Q_{IN}}{5200 \eta_{SS} Q_{IN} + 2.5(1 + 0.7)(4600) \eta_U Q_F}$$

where:

5200 = average annual heating degree-days

$\eta_{SS}$  as defined in 4.3 of this appendix for condensing furnaces and boilers measured by the optional direct condensate measurement method; as



$\eta_{ss,WT}$  as defined in 4.5.14 of this appendix at each design heating requirement for modulating furnaces and boilers; or as  $\text{Effy}_{ss}$  as defined in 11.2.5 of ANSI/ASHRAE 103-82 for all other furnaces and boilers

$\eta_U$  = as defined in 4.3 of this appendix for condensing furnaces and boilers measured by the optional direct condensate measurement method; as  $\eta_{U,WT}$  as defined in 4.5.1 of this appendix at each design heating requirement for modulating furnaces and boilers; or as  $\text{Effy}_{ss}$  as defined in 11.2.5 of ANSI/ASHRAE 103-82 and in 4.2 of this appendix for all other furnaces and boilers except that  $C_j$  and  $L_j$  are defined as:

$C_j$  =

- 0 for furnaces or boilers intended to be installed indoors
- 3.3 for furnaces intended to be installed outdoors
- 1.7 for furnaces intended to be installed as isolated combustion systems
- 4.7 for boilers intended to be installed outdoors
- 2.4 for boilers intended to be installed as isolated combustion systems

$L_j$  = jacket loss and is either assigned the value of 1 percent or determined in accordance with 8.6 of ANSI/ASHRAE 103-82 in percent

$Q_{IN}$  = steady-state heat input as defined in 11.2.34 of ANSI/ASHRAE 103-82

0.7 = average oversizing factor for furnaces and boilers

4600 = average non-heating season hours per year

$Q_P$  = pilot flame fuel input rate as defined in 9.2 of ANSI/ASHRAE 103-82

4.7 National average number of burner operating hours. For furnaces and boilers equipped with single stage thermostats, calculate the national average number of burner operating hours ( $\text{BOH}_{ss}$ ) defined as:

$\text{BOH}_{ss} = 2080(0.77)A \text{ DHR} - 2080 B$

where:

2080 = national average heating load hours

0.77 = adjustment factor which serves to adjust the calculated design heating requirement and heating load hours to the actual heating load experienced by a heating system

DHR = typical design heating requirements, as listed in Table 1 of this appendix using the proper value of  $Q_{OUT}$  where:

$Q_{OUT} = (\eta_{ss}/100 - (K)(L_j)/100)(Q_{IN})$  rounded off to the nearest 1,000 Btu/hr

where:

$\eta_{ss}$  as defined in 4.3 of this appendix for condensing furnaces and boilers measured by the optional direct condensate measurement method; as  $\eta_{ss,WT}$  as defined in 4.5.14 of this appendix at each design heating requirement for modulating furnaces and boilers; or as  $\text{Effy}_{ss}$  as defined in 11.2.5 of

ANSI/ASHRAE 103-82 for all other furnaces and boilers.

$Q_{IN}$  as defined in 11.2.34 of ANSI/ASHRAE 103-82

$K$  = factor that adjusts jacket losses measured in the laboratory to those that would be measured under outdoor design conditions.

0 for furnaces or boilers intended to be installed indoors.

1.7 for furnaces or boilers intended to be installed as isolated combustion systems.

3.3 for furnaces or boilers intended to be installed outdoors.

1.0 for finned tubed boilers intended for installation outdoors.

$L_j$  = jacket loss

$A = 100,000/[341,300(\text{PE} + y \text{ BE}) + (Q_{IN} - Q_P)\eta_U]$

$B = 2 Q_P \eta_U A / 100,000$

100,000 = factor that accounts for percent and kBtu

$\text{PE}$  = power burner electrical energy input rate at full-load steady-state operation, as defined in 9.1 of ANSI/ASHRAE 103-82

ratio of average blower or pump on time to average burner on time

1, for furnaces without a fan delay

1, for boilers without a pump delay

$1 + (t^* - t^*)/3.87$ , for single stage furnaces with fan delay

$1 + (t^* - t^*)/10.00$ , for two stage and step modulating furnaces with fan delay

$1 + (t^*/9.68)$ , for single stage boilers with pump delay

$1 + (t^*/15.00)$ , for two stage and step modulating boilers with pump delay

$\text{BE}$  = circulating air fan (or circulating water pump) electrical energy input rate at full-load steady-state operation, as defined in 9.1 of ANSI/ASHRAE 103-82

$Q_{IN}$  = as defined in 11.2.34 of ANSI/ASHRAE 103-82

$Q_P$  = as defined in 11.2.34 of ANSI/ASHRAE 103-82

$\eta_U$  = as defined in 4.6 of this appendix

2 = ratio of the average length of a heating season in hours to the average heating load hours

$t^*$  = as defined in 3.3 of this appendix

$t^*$  = as defined in 9.3.1 of ANSI/ASHRAE 103-82

For furnaces and boilers equipped with two stage thermostats or step-modulating thermostats, calculate the national average number of burner operating hours at the reduced operating mode ( $\text{BOH}_{RED}$ ) defined as:

$\text{BOH}_{RED} = X_1 E_M / Q_{IN,RED}$

where:

$X_1$  = as defined in 4.5.2 of this appendix

$E_M$  = average annual energy used during the heating season

$E_M = (Q_{IN,MAX} - Q_P)\text{BOH}_{ss} + (8760 - 4600)Q_P$

$Q_{IN,RED}$  = as defined in 4.5.6 of this appendix

$Q_{IN,MAX}$  = as defined in 4.5.7 of this appendix

$Q_P$  = as defined in 11.2.34 of ANSI/ASHRAE 103-82

$\text{BOH}_{ss}$  = as defined in 4.7 of this appendix in which  $\eta_{U,WT}$  replaces  $\eta_U$  for calculating

the values of  $A$  and  $B$  and the term  $(\text{PE} + y \text{ BE})$  in the factor  $A$  is increased by the ratio,  $R$ . It is defined as:

$R =$

- 2.3 for two stage controls
- 2.3 for step-modulating controls when the ratio of minimum-to-maximum output is greater than or equal to 0.5
- 3.0 for step modulating controls when the ratio of minimum-to-maximum out is less than 0.5

$A = 100,000/[341,300(\text{PE} + y \text{ BE})R + (Q_{IN} - Q_P)\eta_U]$

8760 = total number of hours per year

4600 = as defined in 4.6 of this appendix

For furnaces and boilers equipped with two stage thermostats, calculate the national average number of burner operating hours at the maximum operating mode ( $\text{BOH}_{MAX}$ ) defined as:

$\text{BOH}_{MAX} = X_2 E_M / Q_{IN,MAX}$

where:

$X_2$  = as defined in 4.5.3 of this appendix

$E_M$  = as defined in 4.7 of this appendix

$Q_{IN,MAX}$  = as defined in 4.5.7 of this appendix

For furnaces and boilers equipped with step-modulating thermostats, calculate the national average number of burner operating hours in the modulating mode ( $\text{BOH}_{MOD}$ ) defined as:

$\text{BOH}_{MOD} = X_2 E_M / Q_{IN,MOD}$

where:

$X_2$  = as defined in 4.5.3 of this appendix

$E_M$  = as defined in 4.7 of this appendix

$Q_{IN,MOD}$  = as defined in 4.5.12 of this appendix

4.8 Average annual fuel energy consumption for gas or oil fueled furnaces or boilers. For furnaces and boilers equipped with single stage thermostats, calculate the average annual fuel energy consumption for gas or oil fueled furnaces or boilers ( $E_F$ ) expressed in Btu's per year and defined as:

$E_F = \text{BOH}(Q_{IN} - Q_P) + 8760 Q_P$

where:

$\text{BOH}$  = as defined in 4.7 of this appendix

$Q_{IN}$  = as defined in 11.2.34 of ANSI/ASHRAE 103-82

$Q_P$  = as defined in 11.2.34 of ANSI/ASHRAE 103-82

8760 = as defined in 4.7 of this appendix

For furnaces and boilers equipped with either two stage thermostats or step-modulating thermostats, calculate  $E_F$  as defined as:

$E_F = E_M + 4600 Q_P$

where:

$E_M$  = as defined in 4.7 of this appendix

4600 = as defined in 4.6 of this appendix

$Q_P$  = as defined in 11.2.34 of ANSI/ASHRAE 103-82

4.9 Average annual auxiliary electrical energy consumption for gas or oil fueled furnaces or boilers. For furnaces and boilers equipped with single stage thermostats, calculate the average annual auxiliary electrical energy consumption ( $E_{AE}$ ) expressed in kilowatt-hours per year and defined as:



$$E_{AE} = BOH_{SS} (PE + y BE)$$

where:

BOH<sub>SS</sub> = as defined in 4.7 of this appendix  
PE = as defined in 9.1 of ANSI/ASHRAE 103-82

y = as defined in 4.7 of this appendix

BE = as defined in 9.1 of ANSI/ASHRAE 103-82

For furnaces and boilers equipped with two stage thermostats, calculate  $E_{AE}$  defined as:

$$E_{AE} = BOH_{RED} (PE_{RED} + y BE_{RED}) + BOH_{MAX} (PE_{MAX} + y BE_{MAX})$$

where:

BOH<sub>RED</sub> = as defined in 4.7 of this appendix  
PE<sub>RED</sub> = as defined in 9.1 of ANSI/ASHRAE 103-82, measured at the reduced fuel input rate

y = as defined in 4.7 of this appendix

BE<sub>RED</sub> = as defined in 9.1 of ANSI/ASHRAE 103-82, measured at the reduced fuel input rate

BOH<sub>MAX</sub> = as defined in 4.7 of this appendix  
PE<sub>MAX</sub> = as defined in 9.1 of ANSI/ASHRAE 103-82, measured at the maximum fuel input rate

BE<sub>MAX</sub> = as defined in 9.1 of ANSI/ASHRAE 103-82, measured at the maximum fuel input rate

For furnaces and boilers equipped with step-modulating thermostats, calculate  $E_{AE}$  defined as:

$$E_{AE} = BOH_{RED} (PE_{RED} + y BE_{RED}) + BOH_{MOD} (PE_{MAX} + y BE_{MAX})$$

where:

BOH<sub>RED</sub> = as defined in 4.7 of this appendix  
PE<sub>RED</sub> = as defined in 4.9 of this appendix  
y = as defined in 4.7 of this appendix  
BE<sub>RED</sub> = as defined in 4.9 of this appendix  
BOH<sub>MOD</sub> = as defined in 4.7 of this appendix  
PE<sub>MAX</sub> = as defined in 4.9 of this appendix  
BE<sub>MAX</sub> = as defined in 4.9 of this appendix

4.10 *Average annual electric energy consumption for electric furnaces or boilers.* For electric furnaces and boilers, calculate the average annual electric energy consumption ( $E_E$ ) expressed in kilowatt-hours per year and defined as:

$$E_E = 100(2080)(0.77) DHR/3.412 AFUE$$

where:

100 = conversion to express a percent as a decimal

2080 = as defined in 4.7 of this appendix

0.77 = as defined in 4.7 of this appendix

DHR = as defined in 4.7 of this appendix

3.412 = conversion to express energy in terms of watt-hours instead of Btu

AFUE = as defined in 4.1 of this appendix

4.11 *Average annual fuel energy consumption for gas or oil fueled furnaces or boilers located in different geographic regions of the United States and in buildings with different design heating requirements.* For gas or oil fueled furnaces and boilers, calculate the average annual fuel energy consumption for a specific geographic region and for a specific typical design heating requirement ( $E_{FR}$ ) expressed in Btu's per year and defined as:

$$E_{FR} = [(E_F - 8760 Q_P)HLH/2080] + 8760 Q_P$$

where:

$E_F$  = as defined in 4.8 of this appendix

8760 = as defined in 4.7 of this appendix

$Q_P$  = as defined in 11.2.34 of ANSI/ASHRAE 103-82

HLH = heating load hours for a specific geographic region determined in accordance with the heating load hour map in Figure 1 of this appendix

2080 = as defined in 4.7 of this appendix

4.12 *Average annual auxiliary electrical energy consumption for gas or oil fueled furnaces or boilers located in different geographic regions of the United States and in buildings with different design heating requirements.* For gas or oil fueled furnaces and boilers, calculate the average annual auxiliary electrical energy consumption for a specific geographic region and for a specific typical design heating requirement ( $E_{AER}$ ) expressed in kilowatt-hours per year and defined as:

$$E_{AER} = E_{AE}HLH/2080$$

where:

$E_{AE}$  = as defined in 4.9 of this appendix

HLH = as defined in 4.11 of this appendix

2080 = as defined in 4.7 of this appendix

4.13 *Average annual electric energy consumption for electric furnaces or boilers located in different geographic regions of the United States and in buildings with different design heating requirements.* For electric furnaces and boilers, calculate the average annual electric energy consumption for a specific geographic region and for a specific typical design heating requirement ( $E_{ER}$ ) expressed in kilowatt-hours per year and defined as:

$$E_{ER} = 100(0.77)DHR HLH/3.412 AFUE$$

where:

100 = as defined in 4.10 of this appendix

0.77 = as defined in 4.7 of this appendix

DHR = as defined in 4.7 of this appendix

HLH = as defined in 4.11 of this appendix

3.412 = as defined in 4.10 of this appendix

AFUE = as defined in 4.1 of this appendix

4.14 *Energy factor.* For electric furnaces and boilers, the energy factor (EF) is equal to AFUE, as defined in section 4.1 of this appendix. For gas and oil furnaces and boilers, calculate EF as defined as:

$$EF = \eta_U [E_F - 4600 Q_P] / [E_F + 3412 E_{AE}]$$

where:

$\eta_U$  = as defined in 4.6 of this appendix

$E_F$  = as defined in 4.8 of this appendix

4600 = as defined in 4.6 of this appendix

$Q_P$  = as defined in 11.2.34 of ANSI/ASHRAE 103-82

3412 = as defined in 4.10 of this appendix

$E_{AE}$  = as defined in 4.9 of this appendix

TABLE 1.—AVERAGE AND TYPICAL DESIGN HEATING REQUIREMENTS FOR FURNACES AND BOILERS WITH DIFFERENT OUTPUT CAPACITIES

Furnace or boiler output capacity, $Q_{out}$ (Btu/hr)	Average design heating requirements (KBTU/hr)	Typical design heating requirements (KBTU/hr)
5,000-10,000	5	5
11,000-16,000	10	5, 10
17,000-25,000	15	10, 15
26,000-34,000	20	15, 20
35,000-42,000	25	20, 25, 30
43,000-51,000	30	25, 30, 35
52,000-59,000	35	30, 35, 40, 45
60,000-75,000	40	35, 40, 45, 50
77,000-93,000	50	40, 45, 50, 60
94,000-110,000	60	50, 60, 70, 80
111,000-127,000	70	60, 70, 80, 90
128,000-144,000	80	70, 80, 90, 100
145,000-161,000	90	80, 90, 100, 110, 120
162,000-178,000	100	90, 100, 110, 120, 130
179,000-195,000	110	100, 110, 120, 130, 140
over 196,000	130	120, 130, 140, 150, 160

TABLE 2.—AVERAGE BURNER ON-TIME AND OFF-TIME PER CYCLE FOR FURNACES AND BOILERS (MINUTES)

Thermostat type	Furnaces		Boilers	
	$t_{on}$	$t_{off}$	$t_{on}$	$t_{off}$
Single stage	3.87	13.3	9.68	33.26
Two stage	10.0	10.0	15.0	15.0
Step modulating	10.0	10.0	15.0	15.0

TABLE 3.—FRACTIONAL HEATING LOADS AND AVERAGE OUTDOOR TEMPERATURES FOR FURNACES AND BOILERS EQUIPPED WITH MODULATING CONTROLS

Balance point temperature range (°F)	Fractional heating load		Average outdoor temperature (°F)	
	Reduced rate	Modulating or maximum rate	Reduced rate	Modulating or maximum rate
( $T_c$ )	( $X_1$ )	( $X_2$ )	( $T_{0A}$ )	( $T_{0A}^*$ )
6 to 15	0.95	0.05	41	9
16 to 20	0.90	0.10	42	14
21 to 25	0.84	0.16	43	18
26 to 28	0.77	0.23	44	22
29 to 31	0.70	0.30	45	24
32 to 33	0.66	0.34	46	26
34 to 35	0.60	0.40	47	27
36 to 37	0.54	0.46	48	28
38 to 39	0.48	0.52	48	30
40 to 41	0.42	0.58	49	31
42 to 43	0.35	0.65	50	32
44 to 45	0.29	0.71	51	33
46 to 47	0.23	0.77	52	35
48 to 49	0.18	0.82	54	36
50 to 52	0.12	0.88	55	37
53 to 57	0.07	0.93	58	39
58 to 62	0.02	0.98	61	40

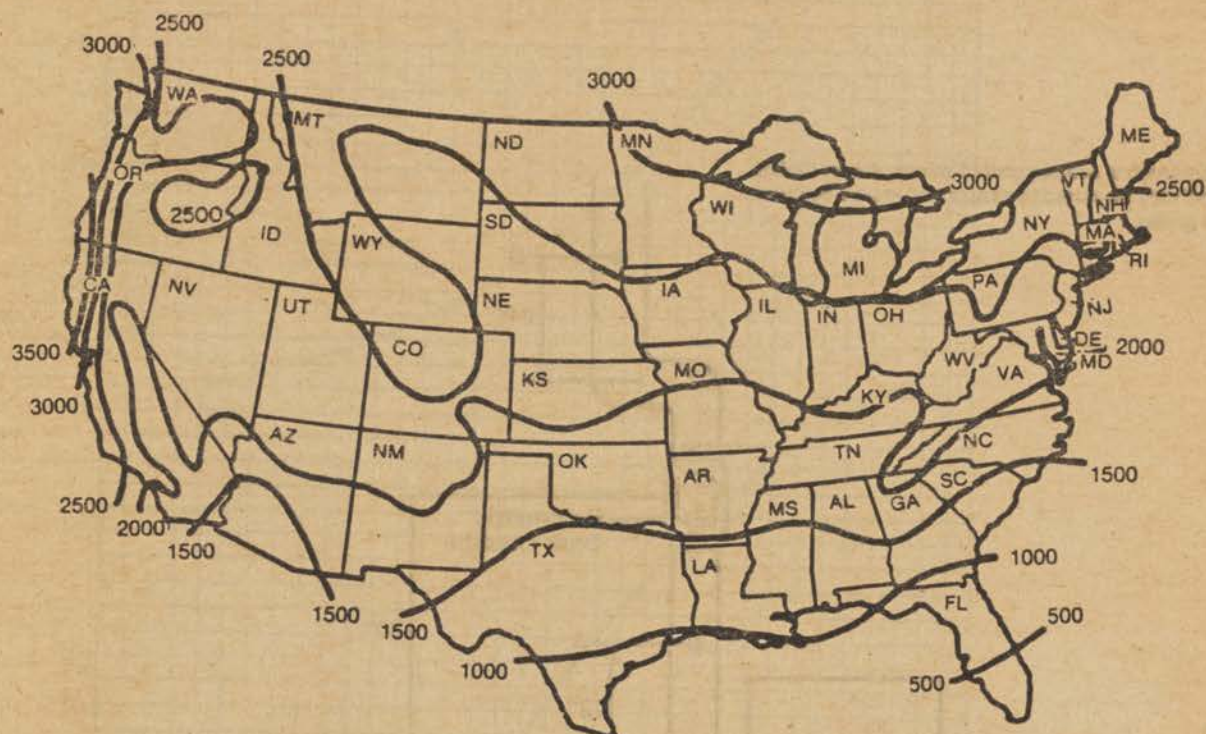
NOTE.—This table is based on national average 5,200 degree-days.

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**FIGURE I**

Heating Load Hours (HLH) for the United States and Territories



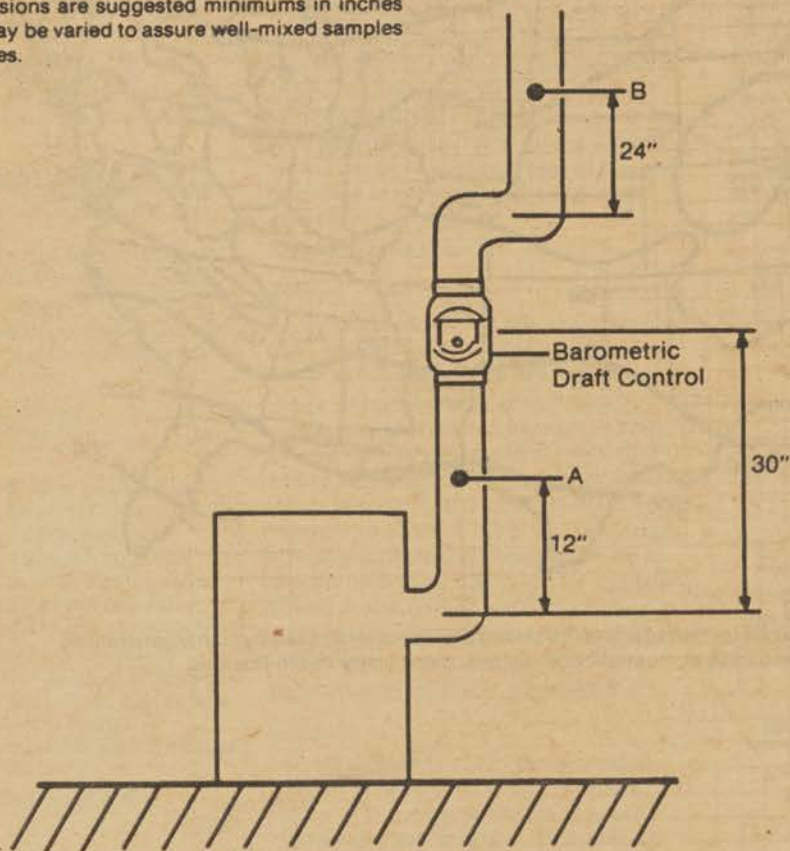
This map is reasonably accurate for most parts of the United States but is necessarily highly generalized and consequently not too accurate in mountainous regions, particularly in the Rockies.

Alaska — 3500 HLH  
Hawaii and Territories — 0 HLH

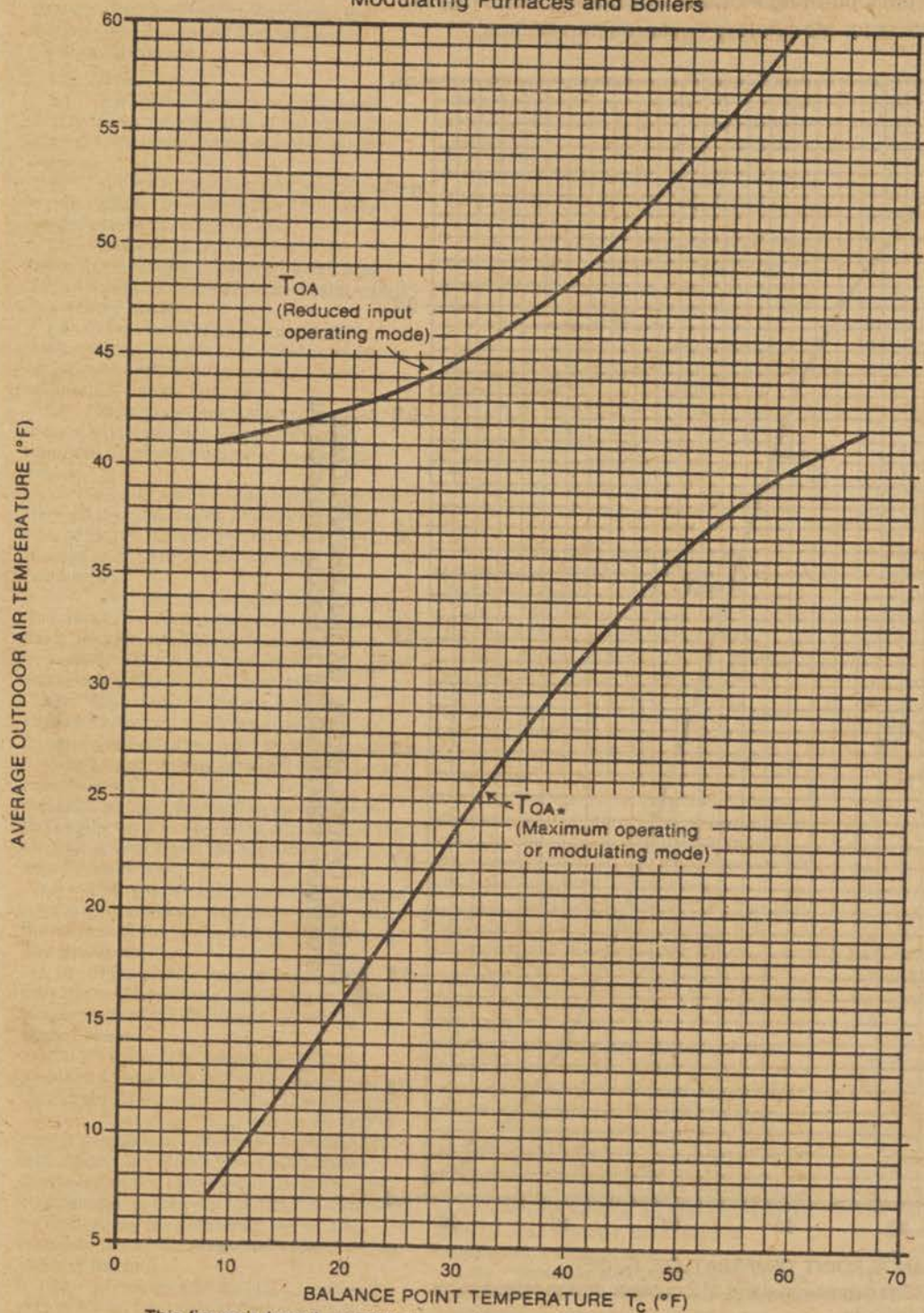


**FIGURE 2****Test Setup for Measuring S/F for Furnaces and Boilers  
with Barometric Draft Controls**

Note: Dimensions are suggested minimums in inches and may be varied to assure well-mixed samples of gases.





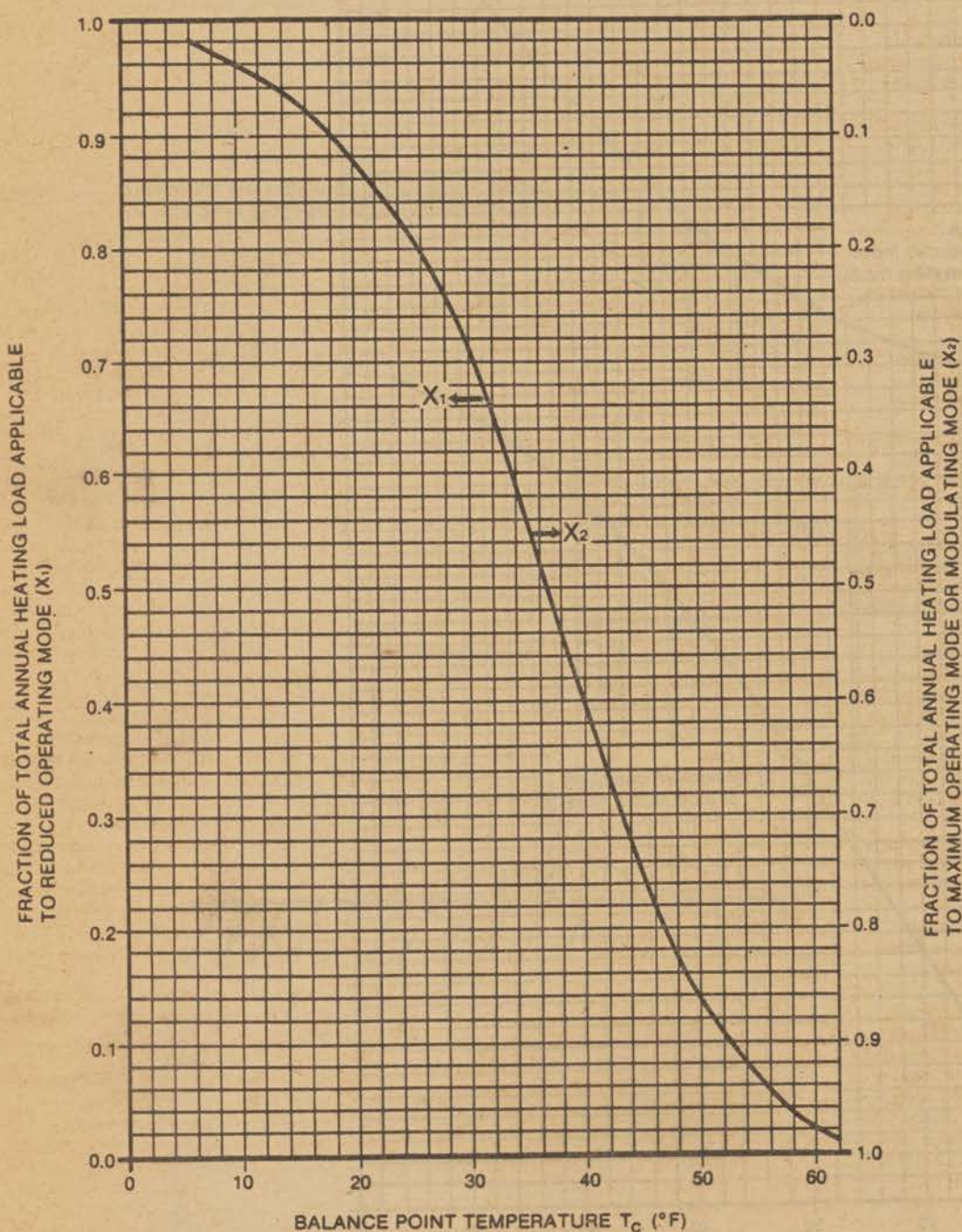
**FIGURE 3**Average Outdoor Air Temperature vs. Balance Point Temperature for  
Modulating Furnaces and Boilers

This figure is based on 5200 degree-days and 5°F outdoor design temperature.



**FIGURE 4**

Fraction of Total Annual Heating Load Applicable to Reduced Operating Mode ( $X_1$ ) and to Maximum Operating Mode or Modulating Mode ( $X_2$ ) vs. Balance Point Temperature for Modulating Furnaces and Boilers.



This figure is based on 5200 degree-days and 5°F outdoor design temperature.



5. Appendix O to Subpart B of Part 430 is revised to read as follows:

**Appendix O to Subpart B of Part 430—Uniform Test Method for Measuring the Energy Consumption of Vented Home Heating Equipment**

**1.0 Definitions.**

- 1.1 "Air shutter" means an adjustable device for varying the size of the primary air inlet(s) to the combustion chamber power burner.
- 1.2 "Air tube" means a tube which carries combustion air from the burner fan to the burner nozzle for combustion.
- 1.3 "Barometric draft regulator or barometric damper" means a mechanical device designed to maintain a constant draft in a vented heater.
- 1.4 "Draft hood" means an external device which performs the same function as an integral draft diverter, as defined in section 1.17 of this appendix.
- 1.5 "Electro-mechanical stack damper" means a type of stack damper which is operated by electrical and/or mechanical means.
- 1.6 "Excess air" means air which passes through the combustion chamber and the vented heater flues in excess of that which is theoretically required for complete combustion.
- 1.7 "Flue" means a conduit between the flue outlet of a vented heater and the integral draft diverter, draft hood, barometric damper or vent terminal through which the flue gases pass prior to the point of draft relief.
- 1.8 "Flue damper" means a device installed between the furnace and the integral draft diverter, draft hood, barometric draft regulator, or vent terminal which is not equipped with a draft control device, designed to open the venting system when the appliance is in operation and to close the venting system when the appliance is in a standby condition.
- 1.9 "Flue gases" means reaction products resulting from the combustion of a fuel with the oxygen of the air, including the inerts and any excess air.
- 1.10 "Flue losses" means the sum of sensible and latent heat losses above room temperature of the flue gases leaving a vented heater.
- 1.11 "Flue outlet" means the opening provided in a vented heater for the exhaust of the flue gases from the combustion chamber.
- 1.12 "Heat input" ( $Q_{in}$ ) means the rate of energy supplied in a fuel to a vented heater operating under steady-state conditions, expressed in Btu's per hour. It includes any input energy to the pilot light and is obtained by multiplying the measured rate of fuel consumption by the measured higher heating value of the fuel.
- 1.13 "Heating capacity" ( $Q_{out}$ ) means the rate of useful heat output from a vented heater, operating under steady-state conditions, expressed in Btu's per hour. For room and wall heaters, it is obtained by multiplying the "heat input" ( $Q_{in}$ ) by the steady-state efficiency ( $\eta_{ss}$ ) divided by 100. For floor furnaces, it is obtained by multiplying (A) the "heat input" ( $Q_{in}$ ) by (B) the steady-state efficiency divided by 100, minus the quantity (2.8) ( $L_j$ ) divided by 100,

where  $L_j$  is the jacket loss as determined in section 3.2 of this appendix.

1.14 "Higher heating value" (HHV) means the heat produced per unit of fuel when complete combustion takes place at constant pressure and the products of combustion are cooled to the initial temperature of the fuel and air and when the water vapor formed during combustion is condensed. The higher heating value is usually expressed in Btu's per pound, Btu's per cubic foot for gaseous fuel, or Btu's per gallon for liquid fuel.

1.15 "Induced draft" means a method of drawing air into the combustion chamber by mechanical means.

1.16 "Infiltration parameter" means that portion of unconditioned outside air drawn into the heated space as a consequence of loss of conditioned air through the exhaust system of a vented heater.

1.17 "Integral draft diverter" means a device which is an integral part of a vented heater, designed to: (1) Provide for the exhaust of the products of combustion in the event of no draft, back draft, or stoppage beyond the draft diverter, (2) prevent a back draft from entering the vented heater, and (3) neutralize the stack action of the chimney or gas vent upon the operation of the vented heater.

1.18 "Manually controlled vented heaters" means either gas or oil fueled vented heaters equipped without thermostats.

1.19 "Modulating control" means either a step-modulating or two-stage control.

1.20 "Power burner" means a vented heater burner which supplies air for combustion at a pressure exceeding atmospheric pressure, or a burner which depends on the draft induced by a fan incorporated in the furnace for proper operation.

1.21 "Reduced heat input rate" means the factory adjusted lowest reduced heat input rate for vented home heating equipment equipped with either two stage thermostats or step-modulating thermostats.

1.22 "Single stage thermostat" means a thermostat that cycles a burner at the maximum heat input rate and off.

1.23 "Stack" means the portion of the exhaust system downstream of the integral draft diverter, draft hood or barometric draft regulator.

1.24 "Stack damper" means a device installed downstream of the integral draft diverter, draft hood, or barometric draft regulator, designed to open the venting system when the appliance is in operation and to close off the venting system when the appliance is in the standby condition.

1.25 "Stack gases" means the flue gases combined with dilution air that enters at the integral draft diverter, draft hood or barometric draft regulator.

1.26 "Steady-state conditions for vented home heating equipment" means equilibrium conditions as indicated by temperature variations of not more than 5° F (2.8°C) in the flue gas temperature for units equipped with draft hoods, barometric draft regulators or direct vent systems, in three successive readings taken 15 minutes apart or not more than 3° F (1.7°C) in the stack gas temperature for units equipped with integral draft diverters in three successive readings taken 15 minutes apart.

1.27 "Step-modulating control" means a control that either cycles off and on at the low input if the heating load is light, or gradually, increases the heat input to meet any higher heating load that cannot be met with the low firing rate.

1.28 "Thermal stack damper" means a type of stack damper which is dependent for operation exclusively upon the direct conversion of thermal energy of the stack gases into movement of the damper plate.

1.29 "Two stage control" means a control that either cycles a burner at the reduced heat input rate and off or cycles a burner at the maximum heat input rate and off.

1.30 "Vaporizing-type oil burner" means a device with an oil vaporizing bowl or other receptacle designed to operate by vaporizing liquid fuel oil by the heat of combustion and mixing the vaporized fuel with air.

1.31 "Vent/air intake terminal" means a device which is located on the outside of a building and is connected to a vented heater by a system of conduits. It is composed of an air intake terminal through which the air for combustion is taken from the outside atmosphere and a vent terminal from which flue gases are discharged.

1.32 "Vent limiter" means a device which limits the flow of air from the atmospheric diaphragm chamber of a gas pressure regulator to the atmosphere. A vent limiter may be a limiting orifice or other limiting device.

1.33 "Vent pipe" means the passages and conduits in a direct vent system through which gases pass from the combustion chamber to the outdoor air.

**2.0 Testing conditions.**

**2.1 Installation of test unit.**

2.1.1 *Vented wall furnaces (including direct vent systems).* Install gas fueled vented wall furnaces for test as specified in sections 2.1.3 and 2.1.4 of ANSI Z21.49-1975. Install gas fueled wall furnaces with direct vent systems for test as described in sections 2.1.3 and 2.1.4 of ANSI Z21.44-1973. Install oil fueled vented wall furnaces as specified in UL-730-1974, section 33. Install oil fueled vented wall furnaces with direct vent systems as specified in UL-730-1974, section 34.

2.1.2 *Vented floor furnaces.* Install vented floor furnaces for test as specified in sections 35.1 through 35.5 of UL-729-1976.

2.1.3 *Vented room heaters.* Install in accordance with manufacturer's instructions.

**2.2 Flue and stack requirements.**

2.2.1 *Gas fueled vented home heating equipment employing integral draft diverters and draft hoods (excluding direct vent systems).* Attach to, and vertically above the outlet of gas fueled vented home heating equipment employing draft diverters or draft hoods with vertically discharging outlets, a five (5) foot long test stack having a cross sectional area the same size as the draft diverter outlet.

Attach to the outlet of vented heaters having a horizontally discharging draft diverter or draft hood outlet a 90 degree elbow, and a five (5) foot long vertical test stack. A horizontal section of pipe may be used on the floor furnace between the diverter and the elbow if necessary to clear



any framing used in the installation. Use the minimum length of pipe possible for this section. Use stack, elbow, and horizontal section with same cross sectional area as the diverter outlet.

**2.2.2 Oil fueled vented home heating equipment (excluding direct vent systems).** Use flue connections for oil fueled vented floor furnaces as specified in section 35 of UL 729-1976, sections 34.10 through 34.18 of UL 730-1974 for oil fueled vented wall furnaces and sections 36.2 and 36.3 of UL 896-1973 for oil fueled vented room heaters.

**2.2.3 Direct vent systems.** Have the exhaust/air intake system supplied by the manufacturer in place during all tests. Test units intended for installation with a variety of vent pipe lengths with the minimum length recommended by the manufacturer. Do not connect a heater employing a direct vent system to a chimney or induced draft source. Vent the gas solely on the provision for venting incorporated in the heater and the vent/air intake system supplied with it.

### 2.3 Fuel supply.

**2.3.1 Natural gas.** For a vented heater utilizing natural gas, maintain the gas supply to the unit under test at a normal inlet test pressure immediately ahead of all controls at 7 to 10 inches water column. Maintain the regulator outlet pressure at normal test pressure approximately at that recommended by the manufacturer. Use natural gas having a specific gravity of approximately 0.65 and a higher heating value within  $\pm 5$  percent of 1,025 Btu's per standard cubic foot. Determine the actual higher heating value in Btu's per standard cubic foot for the natural gas to be used in the test with an error no greater than one percent.

**2.3.2 Propane gas.** For a vented heater utilizing propane gas, maintain the gas supply to the unit under test at a normal inlet pressure of 11 to 13 inches water column and a specific gravity of approximately 1.53. Maintain the regulator outlet pressure, on units so equipped, approximately at that recommended by the manufacturer. Use propane having a specific gravity of approximately 1.53 and a higher heating value within  $\pm 5$  percent of 2,500 Btu's per standard cubic foot. Determine the actual higher heating value in Btu's per standard cubic foot for the propane to be used in the test with an error no greater than one percent.

**2.3.3 Other test gas.** Use other test gases with characteristics as described in section 2.2, table VII, of ANSI Standard Z21.11.1-1974. Use gases with a measured higher heating value within  $\pm 5$  percent of the values specified in the above ANSI standard. Determine the actual higher heating value of the gas used in the test with an error no greater than one percent.

**2.3.4 Oil supply.** For a vented heater utilizing fuel oil, use No. 1, fuel oil (kerosene) for vaporizing-type burners and either No. 1 or No. 2 fuel oil, as specified by the manufacturer, for mechanical atomizing type burners. Use No. 1 fuel oil with a viscosity meeting the specifications as specified in UL-730-1974, section 36.9. Use test fuel conforming to the specifications given in tables 2 and 3 of ANSI Standard Z91.1-1972

for No. 1 and No. 2 fuel oil. Measure the higher heating value of the test fuel with an error no greater than one percent.

**2.3.5 Electrical supply.** For auxiliary electric components of a vented heater, maintain the electrical supply to the test unit within one percent of the nameplate voltage for the entire test cycle. If a voltage range is used for nameplate voltage, maintain the electrical supply within one percent of the mid-point of the nameplate voltage range.

### 2.4 Burner adjustments.

**2.4.1 Gas burner adjustments.** Adjust the burners of gas fueled vented heaters to their maximum Btu ratings at the test pressure specified in section 2.3 of this appendix. Correct the burner volumetric flow rate to 60° F (15.6°C) and 30 inches of mercury barometric pressure, set the fuel flow rate to obtain a heat rate of within  $\pm 2$  percent of the hourly Btu rating specified by the manufacturer as measured after 15 minutes of operation starting with all parts of the vented heater at room temperature. Set the primary air shutters in accordance with the manufacturer's recommendations to give a good flame at this adjustment. Do not allow the deposit of carbon during any test specified herein.

If a vent limiting means is provided on a gas pressure regulator, have it in place during all tests.

For gas fueled heaters with modulating controls adjust the controls to operate the heater at the maximum fuel input rate. Set the thermostat control to the maximum setting. Start the heater by turning the safety control valve to the "on" position. In order to prevent modulation of the burner at maximum input, place the thermostat sensing element in a temperature control bath which is held at a temperature below the maximum set point temperature of the control.

For gas fueled heaters with modulating controls adjust the controls to operate the heater at the reduced fuel input rate. Set the thermostat control to the minimum setting. Start the heater by turning the safety control valve to the "on" position. If ambient test room temperature is above the lowest control set point temperature, initiate burner operation by placing the thermostat sensing element in a temperature control bath that is held at a temperature below the minimum set point temperature of the control.

**2.4.2 Oil burner adjustments.** Adjust the burners of oil fueled vented heaters to give the CO<sub>2</sub> reading recommended by the manufacturer and an hourly Btu input, during the steady-state performance test described below, which is within  $\pm 2$  percent of the heater manufacturer's specified normal hourly Btu input rating. On units employing a power burner do not allow smoke in the flue to exceed a No. 1 smoke during the steady-state performance test as measured by the procedure in ANSI Standard Z11.182-1965 (R1971) (ASTM D 2156-65 (1970)). If, on units employing a power burner, the smoke in the flue exceeds a No. 1 smoke during the steady-state test, readjust the burner to give a lower smoke reading, and, if necessary a lower CO<sub>2</sub> reading, and start all tests over. Maintain the average draft over the fire and in the flue during the steady-state performance test at that recommended by the manufacturer

within  $\pm 0.005$  inches of water gauge. Do not make additional adjustments to the burner during the required series of performance tests. The instruments and measuring apparatus for this test are described in section 6.3 of ANSI standard Z91.1-1972.

### 2.5 Circulating air adjustments.

**2.5.1 Forced air vented wall furnaces (including direct vent systems).** During tests maintain the air flow through the heater as specified by the manufacturer and operate the vented heater with the outlet air temperature between 80° F and 130° F above room temperature. If adjustable air discharge registers are provided, adjust them so as to provide the maximum possible air restriction. Measure air discharge temperature as specified in section 2.14 of ANSI Z21.49-1975.

**2.5.2 Fan type vented room heaters and floor furnaces.** During tests on fan type furnaces and heaters, adjust the air flow through the heater as specified by the manufacturer. If adjustable air discharge registers are provided, adjust them to provide the maximum possible air restriction.

### 2.6 Location of temperature measuring instrumentation.

**2.6.1 Gas fueled vented home heating equipment (including direct vent systems).** For units employing an integral draft diverter, install nine thermocouples, wired in parallel, in a horizontal plane in the five foot test stack located one foot from the test stack inlet. Equalize the length of all thermocouple leads before paralleling. Locate one thermocouple in the center of the stack. Locate eight thermocouples along imaginary lines intersecting at right angles in this horizontal plane at points one third and two thirds of the distance between the center of the stack and the stack wall.

For units which employ a direct vent system, locate at least one thermocouple at the center of each flue way exiting the heat exchanger. Provide radiation shields if the thermocouples are exposed to burner radiation.

For units which employ a draft hood or units which employ a direct vent system which does not significantly preheat the incoming combustion air, install nine thermocouples, wired in parallel, in a horizontal plane located within 12 inches (304.8 mm) of the heater outlet and upstream of the draft hood on units so equipped. Locate one thermocouple in the center of the pipe and eight thermocouples along imaginary lines intersecting at right angles in this horizontal plane at points one third and two thirds of the distance between the center of the pipe and the pipe wall.

For units which employ direct vent systems that significantly preheat the incoming combustion air, install nine thermocouples, wired in parallel, in a plane parallel to and located within 6 inches (152.4 mm) of the vent/air intake terminal. Equalize the length of all thermocouple leads before paralleling. Locate one thermocouple in the center of the vent pipe and eight thermocouples along imaginary lines intersecting at right angles in this plane at points one third and two thirds of the distance between the center of the flue pipe and the pipe wall.



Use bead-type thermocouples having wire size not greater than No. 24 American Wire Gauge (AWG). If there is a possibility that the thermocouples could receive direct radiation from the fire, install radiation shields on the fire side of the thermocouples only and position the shields so that they do not touch the thermocouple junctions.

Install thermocouples for measuring conditioned warm air temperature as described in ANSI Z21.49-1975, section 2.14. Establish the temperature of the inlet air by means of single No. 24 AWG bead-type thermocouple, suitably shielded from direct radiation and located in the center of the plane of each inlet air opening.

**2.6.2 Oil fueled vented home heating equipment (including direct vent systems).** Install nine thermocouples, wired in parallel and having equal length leads, in a plane perpendicular to the axis of the flue pipe. Locate this plane at the position shown in Figure 34.4 of UL 730-1974, or Figures 35.1 and 35.2 of UL 729-1976 for a single thermocouple, except that on direct vent systems which significantly preheat the incoming combustion air, it shall be located within 6 inches (152.5 mm) of the outlet of the vent/air intake terminal. Locate one thermocouple in the center of the flue pipe and eight thermocouples along imaginary lines intersecting at right angles in this plane at points one third and two thirds of the distance between the center of the pipe and pipe wall.

Use bead-type thermocouples having a wire size not greater than No. 24 AWG. If there is a possibility that the thermocouples could receive direct radiation from the fire, install radiation shields on the fire side of the thermocouples only and position the shields so that they do not touch the thermocouple junctions.

Install thermocouples for measuring the conditioned warm air temperature as described in sections 35.12 through 35.17 of UL 730-1974. Establish the temperature of the inlet air by means of a single No. 24 AWG bead-type thermocouple, suitably shielded from direct radiation and located in the center of the plane of each inlet air opening.

**2.7 Combustion measurement instrumentation.** Analyze the samples of stack and flue gases for vented heaters to determine the concentration by volume of carbon dioxide present in the dry gas with instrumentation which will result in a reading having an accuracy of  $\pm 0.1$  percentage points.

**2.8 Energy flow instrumentation.** Install one or more instruments, which measure the rate of gas flow or fuel oil supplied to the vented heater, and if appropriate, the electrical energy with an error no greater than one percent.

**2.9 Room ambient temperature.** During the time period required to perform all the testing and measurement procedures specified in section 3.0 of this appendix, maintain the room temperature within  $\pm 5^\circ\text{F}$  ( $\pm 2.8^\circ\text{C}$ ) of the value  $T_{RA}$  measured during the steady-state performance test. At no time during these tests shall the room temperature exceed  $100^\circ\text{F}$  ( $37.8^\circ\text{C}$ ) or fall below  $65^\circ\text{F}$  ( $18.3^\circ\text{C}$ ).

Temperature ( $T_{RA}$ ) shall be the arithmetic average temperature of the test area,

determined by measurement with four No. 24 AWG bead-type thermocouples with junctions shielded against radiation, located approximately at 90-degree positions on a circle circumscribing the heater or heater enclosure under test, in a horizontal plane approximately at the vertical midpoint of the appliance or test enclosure, and with the junctions approximately 24 inches from sides of the heater or test enclosure and located so as not to be affected by other than room air. Locate a thermocouple at each elevation of draft relief inlet opening and combustion air inlet opening at a distance of approximately 24 inches from the inlet openings. The temperature of the air for combustion and the air for draft relief shall not differ more than  $\pm 5^\circ\text{F}$  from room temperature as measured above.

**2.10 Equipment used to measure mass flow rate in flue and stack.** The tracer gas chosen for this task should have a density which is less than or approximately equal to the density of air. Use a gas unreactive with the environment to be encountered. Using instrumentation of either the batch or continuous type, measure the concentration of tracer gas with an error no greater than 2 percent of the value of the concentration measured.

**3.0 Testing and measurements.**

**3.1 Steady-state testing.**

**3.1.1 Gas fueled vented home heating equipment (including direct vent systems).** Set up the vented heater as specified in sections 2.1, 2.2, and 2.3 of this appendix. The draft diverter shall be in the normal open condition and the stack shall not be insulated. (Insulation of the stack is no longer required for the vented heater test.) Begin the steady-state performance test by operating the burner and the circulating air blower, on units so equipped, with the adjustments specified by sections 2.4.1 and 2.5 of this appendix, until steady-state conditions are attained as indicated by a temperature variation of not more than  $3^\circ\text{F}$  ( $1.7^\circ\text{C}$ ) in the stack gas temperature for vented heaters equipped with draft diverters or  $5^\circ\text{F}$  ( $2.8^\circ\text{C}$ ) in the flue gas temperature for vented heaters equipped with either draft hoods or direct vent systems; in three successive readings taken 15 minutes apart.

On units employing draft diverters, measure the room temperature ( $T_{RA}$ ) as described in section 2.9 of this appendix and measure the steady-state stack gas temperature ( $T_{S,ss}$ ) using the nine thermocouples located in the 5 foot test stack as specified in section 2.6.1 of this appendix. Secure a sample of the stack gases in the plane where  $T_{S,ss}$  is measured or within 3.5 feet downstream of this plane. Determine the concentration by volume of carbon dioxide ( $X_{CO_2s}$ ) present in the dry stack gas. If the location of the gas sampling differs from the temperature measurement plane, there shall be no air leaks through the stack between these two locations.

On units employing draft hoods or direct vent systems, measure the room temperature ( $T_{RA}$ ) as described in section 2.9 of this appendix and measure the steady-state flue gas temperature ( $T_{F,ss}$ ), using the nine thermocouples located in the flue pipe as described in section 2.6.1 of this appendix.

Secure a sample of the flue gas in the plane of temperature measurement and determine the concentration by volume of  $\text{CO}_2$  ( $X_{CO_2F}$ ) present in dry flue gas. In addition, for units employing draft hoods, secure a sample of the stack gas in a horizontal plane in the five foot test stack located one foot from the test stack inlet; and determine the concentration by volume of  $\text{CO}_2$  ( $X_{CO_2s}$ ) present in dry stack gas.

Determine the steady-state heat input rate ( $Q_{in}$ ) including pilot gas by multiplying the measured higher heating value of the test gas by the steady-state gas input rate corrected to standard conditions of  $60^\circ\text{F}$  and 30 inches of mercury. Use measured values of gas temperature and pressure at the meter and the barometric pressure to correct the metered gas flow rate to standard conditions.

After the above test measurements have been completed on units employing draft diverters, secure a sample of the flue gases at the exit of the heat exchanger(s) and determine the concentration of  $\text{CO}_2$  ( $X_{CO_2F}$ ) present. In obtaining this sample of flue gas, move the sampling probe around or use a sample probe with multiple sampling ports in order to assure that an average value is obtained for the  $\text{CO}_2$  concentration. For units with multiple heat exchanger outlets, measure the  $\text{CO}_2$  concentration in a sample from each outlet to obtain the average  $\text{CO}_2$  concentration for the unit. A manifold (parallel connected sampling tubes) may be used to obtain this sample.

For heaters with single stage thermostat control (wall mounted electric thermostats), determine the steady-state efficiency at the maximum fuel input rate as specified in section 2.4 of this appendix.

For gas fueled vented heaters equipped with either two stage thermostats or step-modulating thermostats, determine the steady-state efficiency at the maximum fuel input rate, as specified in section 2.4.1 of this appendix, and at the reduced fuel input rate, as specified in section 2.4.1 of this appendix.

For manually controlled gas fueled vented heaters, with various input rates determine the steady-state efficiency at a fuel input rate that is within  $\pm 5$  percent of 50 percent of the maximum fuel input rate. If the heater is designed to use a control that precludes operation at other than maximum output (single firing rate) determine the steady state efficiency at the maximum input rate only.

**3.1.2 Oil fueled vented home heating equipment (including direct vent systems).** Set up and adjust the vented heater as specified in sections 2.1, 2.2, and 2.3.4 of this appendix. Begin the steady-state performance test by operating the burner and the circulating air blower, on units so equipped, with the adjustments specified by sections 2.4.2 and 2.5 of this appendix until steady-state conditions are attained as indicated by a temperature variation of not more than  $5^\circ\text{F}$  ( $2.8^\circ\text{C}$ ) in the flue gas temperature in three successive readings taken 15 minutes apart.

Do not allow smoke in the flue, for units equipped with power burners, to exceed a No. 1 smoke during the steady-state performance test as measured by the procedure described in ANSI standard Z11.182-1965 (R1971) (ASTM D 2156-65



(1970)). Maintain the average draft over the fire and in the breeching during the steady-state performance test at that recommended by the manufacturer  $\pm 0.005$  inches of water gauge.

Measure the room temperature ( $T_{RA}$ ) as described in section 2.9 of this appendix and measure the steady-state flue gas temperature ( $T_{F,ss}$ ) using nine thermocouples located in the flue pipe as described in section 2.6.2 of this appendix. Secure a sample of the flue gas in the plane of temperature measurement and determine the concentration by volume of  $CO_2$  ( $X_{CO_2}$ ) present in dry flue gas. Measure and record the steady-state heat input rate ( $Q_{in}$ ).

For manually controlled oil fueled vented heaters, determine the steady-state efficiency at a fuel input rate that is within  $\pm 5$  percent of 50 percent of the maximum fuel input rate.

**3.1.3 Auxiliary Electric Power Measurement.** Allow the auxiliary electrical system of a gas or oil vented heater to operate for at least five minutes before recording the maximum auxiliary electric power measurement from the wattmeter. Record the maximum electric power ( $P_E$ ) expressed in kilowatts. For vented heaters with modulating controls, the recorded ( $P_E$ ) shall be maximum measured electric power multiplied by the following factor ( $R$ ). For two stage controls,  $R=1.3$ . For step modulating controls,  $R=1.4$  when the ratio of minimum-to-maximum fuel input is greater than or equal to 0.7,  $R=1.7$  when the ratio of minimum-to-maximum fuel input is less than 0.7 and greater than or equal to 0.5, and  $R=2.2$  when the ratio of minimum-to-maximum fuel input is less than 0.5.

**3.2 Jacket loss measurement.** Conduct a jacket loss test for vented floor furnaces. Measure the jacket loss ( $L_J$ ) in accordance with the ANSI standard Z21.48-1976 section 2.12.

**3.3 Measurement of the off-cycle losses for vented heaters equipped with thermal stack dampers.** Install the thermal stack damper according to the manufacturer's instructions. Unless specified otherwise, the thermal stack damper should be at the draft diverter exit collar. Attach a five foot length of bare stack to the outlet of the damper. Install thermocouples as specified in section 2.6.1 of this appendix.

For vented heaters equipped with single stage thermostats, measure the off-cycle losses at the maximum fuel input rate. For vented heaters equipped with two stage thermostats, measure the off-cycle losses at the maximum fuel input rate and at the reduced fuel input rate. For vented heaters equipped with step-modulating thermostats, measure the off-cycle losses at the reduced fuel input rate.

Let the vented heater heat up to a steady-state condition. Feed a tracer gas at a constant metered rate into the stack directly above and within one foot above the stack damper. Record tracer gas flow rate and temperature. Measure the tracer gas concentration in the stack at several locations in a horizontal plane through a cross section of the stack at a point sufficiently above the stack damper to ensure that the tracer gas is well mixed in the stack.

Continuously measure the tracer gas concentration and temperature during a 10

minute cool down period. Shut the burner off and immediately begin measuring tracer gas concentration in the stack, stack temperature, room temperature, and barometric pressure. Record these values as the midpoint of each one-minute interval between burner shut down and ten minutes after burner shut down. Meter response time and sampling delay time shall be considered in timing these measurements.

**3.4 Measurement of the effectiveness of electro-mechanical stack dampers.** For vented heaters equipped with electro-mechanical stack dampers, measure the cross sectional area of the stack ( $A_s$ ), the net area of the damper plate ( $A_d$ ), and the angle that the damper plate makes when closed with a plane perpendicular to the axis of the stack ( $\Omega$ ). The net area of the damper plate means the area of the damper plate minus the area of any holes through the damper plate.

**3.5 Pilot light measurement.** Measure the energy input rate to the pilot light ( $Q_p$ ) with an error no greater than 3 percent for vented heaters so equipped.

**3.6 Optional procedure for determining  $D_p$ ,  $D_F$  and  $D_s$  for systems for all types of vented heaters.** For all types of vented heaters,  $D_p$ ,  $D_F$  and  $D_s$  can be measured by the following optional cool down test.

Conduct a cool down test by letting the unit heat up until steady-state conditions are reached, as indicated by temperature variation of not more than  $5^\circ F$  ( $2.8^\circ C$ ) in the flue gas temperature in three successive readings taken 15 minutes apart, and then shutting the unit off with the stack or flue damper controls by-passed or adjusted so that the stack or flue damper remains open during the resulting cool down period. If a draft was maintained on oil fueled units in the flue pipe during the steady-state performance test described in section 3.1 of this appendix, maintain the same draft (within a range of  $-0.001$  to  $+0.005$  inches of water gauge of the average steady-state draft) during this cool down period.

Measure the flue gas mass flow rate ( $m_{F,off}$ ) during the cool down test described above at a specific off-period flue gas temperature and corrected to obtain its value at the steady-state flue gas temperature ( $T_{F,ss}$ ), using the procedure described below.

Within one minute after the unit is shut off to start the cool down test for determining  $D_p$ , begin feeding a tracer gas into the combustion chamber at a constant flow rate of  $V_T$ , and at a point which will allow for the best possible mixing with the air flowing through the chamber. (On units equipped with an oil fired power burner, the best location for injecting this tracer gas appears to be through a hole drilled in the air tube.) Periodically measure the value of  $V_T$  with an instantaneous reading flow meter having an accuracy of  $\pm 3$  percent of the quantity measured. Maintain  $V_T$  at less than 1 percent of the air flow rate through the furnace. If a combustible tracer gas is used, there should be a delay period between the time the burner gas is shut off and the time the tracer gas is first injected to prevent ignition of the tracer gas.

Between 5 and 6 minutes after the unit is shut off to start the cool down test, measure at the exit of the heat exchanger the average

flue gas temperature,  $T_{F,off}$ . At the same instant the flue gas temperature is measured, also measure the percent volumetric concentration of tracer gas  $C_T$  in the flue gas in the same plane where  $T_{F,off}$  is determined. Obtain the concentration of tracer gas using an instrument which will result in an accuracy of  $\pm 2$  percent in the value of  $C_T$  measured. If use of a continuous reading type instrument results in a delay time between drawing of a sample and its analysis, this delay should be taken into account so that the temperature measurement and the measurement of tracer gas concentration coincide. In addition, determine the temperature of the tracer gas entering the flow meter ( $T_r$ ) and the barometric pressure ( $P_B$ ).

The rate of the flue gas mass flow through the vented heater and the factors  $D_p$ ,  $D_F$ , and  $D_s$  are calculated by the equations in sections 4.5.1 through 4.5.3 of this appendix.

**4.0 Calculations.**

**4.1 Annual fuel utilization efficiency for gas or oil fueled vented home heating equipment equipped without manual controls and without thermal stack dampers.** The following procedure determines the annual fuel utilization efficiency for gas or oil fueled vented home heating equipment equipped without manual controls and without thermal stack dampers.

**4.1.1 System number.** Obtain the system number from Table 1 of this appendix.

**4.1.2 Off-cycle flue gas draft factor.** Based on the system number, determine the off-cycle flue gas draft factor ( $D_F$ ) from Table 1 of this appendix.

**4.1.3 Off-cycle stack gas draft factor.** Based on the system number, determine the off-cycle stack gas draft factor ( $D_s$ ) from Table 1 of this appendix.

**4.1.4 Pilot fraction.** Calculate the pilot fraction ( $P_F$ ) expressed as a decimal and defined as:

$$P_F = Q_p / Q_{in}$$

where:

$Q_p$  = as defined in 3.5 of this appendix

$Q_{in}$  = as defined in 3.1 of this appendix at the maximum fuel input rate

**4.1.5 Jacket loss for floor furnaces.**

Determine the jacket loss ( $L_J$ ) expressed as a percent and measured in accordance with section 3.2 of this appendix. For other vented heaters  $L_J=0.0$ .

**4.1.6 Latent heat loss.** Based on the fuel, obtain the latent heat loss ( $L_{L,A}$ ) from Table 2 of this appendix.

**4.1.7 Ratio of combustion air mass flow rate to stoichiometric air mass flow rate.** Determine the ratio of combustion air mass flow rate to stoichiometric air mass flow rate ( $R_{T,F}$ ), and defined as:

$$R_{T,F} = A + B / X_{CO_2}$$

where:

$A$  = as determined from Table 2 of this appendix

$B$  = as determined from Table 2 of this appendix

$X_{CO_2}$  = as defined in 3.1 of this appendix

**4.1.8 Ratio of combustion and relief air mass flow rate to stoichiometric air mass flow rate.** For vented heaters equipped with



either an integral draft diverter or a draft hood, determine the ratio of combustion and relief air mass flow rate to stoichiometric air mass flow rate ( $R_{T,S}$ ), and defined as:

$$R_{T,S} = A + [B/X_{CO,S}]$$

where:

A = as determined from Table 2 of this appendix

B = as determined from Table 2 of this appendix

$X_{CO,S}$  = as defined in 3.1 of this appendix

**4.1.9 Sensible heat loss at steady-state operation.** For vented heaters equipped with either an integral draft diverter or a draft hood, determine the sensible heat loss at steady-state operation ( $L_{S,SS,A}$ ) expressed as a percent and defined as:

where:

$$L_{S,SS,A} = C(R_{T,S} + D)(T_{S,SS} - T_{RA})$$

C = as determined from Table 2 of this appendix

$R_{T,S}$  = as defined in 4.1.8 of this appendix

D = as determined from Table 2 of this appendix

$T_{S,SS}$  = as defined in 3.1 of this appendix

$T_{RA}$  = as defined in 2.9 of this appendix

For vented heaters equipped without an integral draft diverter, determine ( $L_{S,SS,A}$ ) expressed as a percent and defined as:

$$L_{S,SS,A} = C(R_{T,F} + D)(T_{F,SS} - T_{RA})$$

where:

C = as determined from Table 2 of this appendix

$R_{T,F}$  = as defined in 4.1.7 of this appendix

D = as determined from Table 2 of this appendix

$T_{F,SS}$  = as defined in 3.1 of this appendix

$T_{RA}$  = as defined in 2.9 of this appendix

**4.1.10 Steady-state efficiency.** For vented heaters equipped with single stage thermostats, calculate the steady-state efficiency (excluding jacket loss,  $\eta_{SS}$ ), expressed in percent and defined as:

$$\eta_{SS} = 100 - L_{L,A} - L_{S,SS,A}$$

where:

$L_{L,A}$  = as defined in 4.1.6 of this appendix

$L_{S,SS,A}$  = as defined in 4.1.9 of this appendix

For vented heaters equipped with either two stage thermostats or with step-modulating thermostats, calculate the steady-state efficiency at the reduced fuel input rate,  $\eta_{SS,L}$ , expressed in percent and defined as:

$$\eta_{SS,L} = 100 - L_{L,A} - L_{S,SS,A}$$

where:

$L_{L,A}$  = as defined in 4.1.6 of this appendix

$L_{S,SS,A}$  = as defined in 4.1.9 of this appendix in which  $L_{S,SS,A}$  is determined at the reduced fuel input rate

For vented heaters equipped with two stage thermostats, calculate the steady-state efficiency at the maximum fuel input rate,  $\eta_{SS,H}$ , expressed in percent and defined as:

$$\eta_{SS,H} = 100 - L_{L,A} - L_{S,SS,A}$$

where:

$L_{L,A}$  = as defined in 4.1.6 of this appendix

$L_{S,SS,A}$  = as defined in 4.1.9 of this appendix in which  $L_{S,SS,A}$  is measured at the maximum fuel input rate

For vented heaters equipped with step-modulating thermostats, calculate the

weighted-average steady-state efficiency in

the modulating mode,  $\eta_{SS-MOD}$ , expressed in percent and defined as:

$$\eta_{SS-MOD} = [\eta_{SS-H} - \eta_{SS-L}] \left[ \frac{T_C - T_{OA}}{T_C - 15} \right] + \eta_{SS-L}$$

where:

$\eta_{SS-H}$  = as defined in 4.1.10 of this appendix

$\eta_{SS-L}$  = as defined in 4.1.10 of this appendix

$T_{OA}$  = average outdoor temperature for vented heaters with step-modulating thermostats operating in the modulating mode and is obtained from Table 3 or Figure 1 of this appendix

$T_C$  = balance point temperature which represents a temperature used to apportion the annual heating load between the reduced input cycling mode and either the modulating mode or maximum input cycling mode and is obtained either from Table 3 of this appendix or calculated by the following equation:

$$T_C = 65 - [(65 - 15)R]$$

where:

65 = average outdoor temperature at which a vented heater starts operating

15 = national average outdoor design temperature for vented heaters

R = ratio of reduced to maximum heat output rates, as defined in 4.1.13 of this appendix

**4.1.11 Reduced heat output rate.** For vented heaters equipped with either two stage thermostats or step-modulating thermostats, calculate the reduced heat output rate

( $Q_{red,out}$ ) defined as:

$$Q_{red,out} = \eta_{SS,L} Q_{red,in}$$

where:

$\eta_{SS,L}$  = as defined in 4.1.10 of this appendix

$Q_{red,in}$  = the reduced fuel input rate

**4.1.12 Maximum heat output rate.** For vented heaters equipped with either two stage thermostats or step-modulating thermostats, calculate the maximum heat output rate ( $Q_{max,out}$ ) defined as:

$$Q_{max,out} = \eta_{SS,H} Q_{max,in}$$

where:

$\eta_{SS,H}$  = as defined in 4.1.10 of this appendix

$Q_{max,in}$  = the maximum fuel input rate

**4.1.13 Ratio of reduced to maximum heat output rates.** For vented heaters equipped with either two stage thermostats or step-modulating thermostats, calculate the ratio of reduced to maximum heat output rates (R) expressed as a decimal and defined as:

$$R = Q_{red,out} / Q_{max,out}$$

where:

$Q_{red,out}$  = as defined in 4.1.11 of this appendix

$Q_{max,out}$  = as defined in 4.1.12 of this appendix

**4.1.14 Fraction of heating load at reduced operating mode.** For vented heaters equipped with either two stage thermostats or step-modulating thermostats, determine the fraction of heating load at the reduced operating mode ( $X_1$ ) expressed as a decimal

and listed in Table 3 of this appendix or obtained from Figure 2 of this appendix.

**4.1.15 Fraction of heating load at maximum operating mode or noncycling mode.** For vented heaters equipped with either two stage thermostats or step-modulating thermostats, determine the fraction of heating load at the maximum operating mode or noncycling mode ( $X_2$ ) expressed as a decimal and listed in Table 3 of this appendix or obtained from Figure 2 of this appendix.

**4.1.16 Weighted-average steady-state efficiency.** For vented heaters equipped with single stage thermostats, the weighted-average steady-state efficiency ( $\eta_{SS-WT}$ ) is equal to  $\eta_{SS}$ , as defined in section 4.1.10 of this appendix. For vented heaters equipped with two stage thermostats,  $\eta_{SS-WT}$  is defined as:

$$\eta_{SS-WT} = X_1 \eta_{SS-L} + X_2 \eta_{SS-H}$$

where:

$X_1$  = as defined in 4.1.14 of this appendix

$\eta_{SS-L}$  = as defined in 4.1.10 of this appendix

$X_2$  = as defined in 4.1.15 of this appendix

$\eta_{SS-H}$  = as defined in 4.1.10 of this appendix

For vented heaters equipped with step-modulating thermostats,  $\eta_{SS-WT}$  is defined as:

$$\eta_{SS-WT} = X_1 \eta_{SS-L} + X_2 \eta_{SS-MOD}$$

where:

$X_1$  = as defined in 4.1.14 of this appendix

$\eta_{SS-L}$  = as defined in 4.1.10 of this appendix

$X_2$  = as defined in 4.1.15 of this appendix

$\eta_{SS-MOD}$  = as defined in 4.1.10 of this appendix

**4.1.17 Annual fuel utilization efficiency.** Calculate the annual fuel utilization efficiency (AFUE) expressed as percent and defined as:

$$AFUE = [0.968 \eta_{SS-WT} - 1.78 D_F - 1.89 D_S - 129 P_F - 2.8 L_J + 1.81]$$

where:

$\eta_{SS-WT}$  = as defined in 4.1.16 of this appendix

$D_F$  = as defined in 4.1.2 of this appendix

$D_S$  = as defined in 4.1.3 of this appendix

$P_F$  = as defined in 4.1.4 of this appendix

$L_J$  = as defined in 4.1.5 of this appendix

**4.2 Annual fuel utilization efficiency for gas or oil fueled vented home heating equipment equipped with manual controls.**

The following procedure determines the annual fuel utilization efficiency for gas or oil fueled vented home heating equipment equipped with manual controls.

**4.2.1 Average ratio of stack gas mass flow rate to flue gas mass flow rate at steady-state operation.** For vented heaters equipped with either direct vents or direct exhaust or are outdoor units, the average ratio of stack gas mass flow rate to flue gas mass flow rate at steady-state operation (S/F) shall be equal to unity. (S/F = 1.) For all other types of vented heaters, calculate (S/F) defined as:

$$S/F = 1.3 R_{T,S} / R_{T,F}$$



where:

$R_{T,S}$  = as defined in 4.1.8 of this appendix with

$X_{CO_2}$  measured at 50% fuel input rate

$R_{T,F}$  = as defined in 4.1.7 of this appendix with

$X_{CO_2}$  measured at 50% fuel input rate

#### 4.2.2 Multiplication factor for infiltration

loss during burner on-cycle. Calculate the

multiplication factor for infiltration loss

during burner on-cycle ( $K_{I,ON}$ ) defined as:

$$K_{I,ON} = 100(0.24) (S/F) (0.7) [1 + R_{T,F}(A/F)] / HHV_A$$

where:

100 = converts a decimal fraction into a

percent

0.24 = specific heat of air

A/F = stoichiometric air/fuel ratio,

determined in accordance with Table 2

of this appendix

S/F = as defined in 4.2.1 of this appendix at 50

percent of rated maximum fuel input

0.7 = infiltration parameter

$R_{T,F}$  = as defined in 4.1.7 of this appendix

$HHV_A$  = average higher heating value of the

test fuel, determined in accordance with

Table 2 of this appendix

#### 4.2.3 On-cycle infiltration heat loss.

Calculate the on-cycle infiltration heat loss

( $L_{I,ON}$ ) expressed as a percent and defined as:

$$L_{I,ON} = K_{I,ON} (70 - 45)$$

where:

$K_{I,ON}$  = as defined in 4.2.2 of this appendix

70 = average indoor temperature

45 = average outdoor temperature

#### 4.2.4 Weighted-Average Steady-State

Efficiency. For manually controlled heaters

with various input rates the weighted average

steady-state efficiency ( $\eta_{SS,WT}$ ), is at 50

percent of the maximum fuel input rate as

measured in either section 3.1.1 to this

appendix for manually controlled gas vented

heaters or section 3.1.2 to this appendix for

manually controlled oil vented heaters. For

manually controlled heater with one single

firing rate the weighted average steady-state

efficiency is the steady state efficiency

measured at the single firing rate.

#### 4.2.5 Part-load fuel utilization efficiency.

Calculate the part-load fuel utilization

efficiency ( $\eta_u$ ) expressed as a percent and

defined as:

$$\eta_u = \eta_{SS,WT} - L_{I,ON}$$

where:

$\eta_{SS,WT}$  = as defined in 4.2.4 of this appendix

$L_{I,ON}$  = as defined in 4.2.3 of this appendix

#### 4.2.6 Annual fuel utilization efficiency.

For manually controlled vented heaters.

Calculate the annual fuel utilization

efficiency (AFUE) expressed as a percent and

defined as:

$$AFUE = \frac{4400\eta_{SS}\eta_u Q_{in,max}}{4400\eta_{SS}Q_{in,max} + 2.5(4600)\eta_u Q_P}$$

where:

4400 = average number of heating degree days

$\eta_{SS}$  = as defined as  $\eta_{SS,WT}$  in 4.2.4 of this

appendix

$\eta_u$  = as defined in 4.2.5 of this appendix

$Q_{in,max}$  = as defined as  $Q_{in}$  at the maximum

fuel input rate, as defined in 3.1 of this

appendix

4600 = average number of non-heating season  
hours per year

$Q_P$  = as defined in 3.5 of this appendix

#### 4.3 Annual fuel utilization efficiency by

the tracer gas method. The annual fuel

utilization efficiency shall be determined by

the following tracer gas method for all vented

heaters equipped with thermal stack

dampers. All other types of vented heaters

can elect to use the following tracer gas

method, as an optional procedure.

#### 4.3.1 On-cycle sensible heat loss.

For vented heaters equipped with single stage

thermostats, calculate the on-cycle sensible

heat loss ( $L_{S,ON}$ ) expressed as a percent and

defined as:

$$L_{S,ON} = L_{S,SS,A}$$

where:

$L_{S,SS,A}$  = as defined in 4.1.9 of this appendix

For vented heaters equipped with two

stage thermostats, calculate  $L_{S,ON}$  defined as:

$$L_{S,SS,A-avg} = \left[ (L_{S,SS,A-max} - L_{S,SS,A-red}) \left[ \frac{T_C - T_{OA}}{T_C - 15} \right] \right] + L_{S,SS,A-red}$$

where:

$L_{S,SS,A-avg}$  = as defined in 4.3.1 of this appendix

$T_C$  = as defined in 4.1.10 of this appendix

$T_{OA}$  = as defined in 4.1.10 of this appendix

15 = as defined in 4.1.10 of this appendix

#### 4.3.2 On-cycle infiltration heat loss.

For vented heaters equipped with single stage

thermostats, calculate the on-cycle

infiltration heat loss ( $L_{I,ON}$ ) expressed as a

percent and defined as:

$$L_{I,ON} = K_{I,ON} (70 - 45)$$

where:

$K_{I,ON}$  = as defined in 4.2.2 of this appendix

70 = as defined in 4.2.3 of this appendix

45 = as defined in 4.2.3 of this appendix

For vented heaters equipped with two

stage thermostats, calculate  $L_{I,ON}$  defined as:

$$K_{I,ON-avg} = \frac{[K_{I,ON,max} + K_{I,ON,red}]}{2}$$

70 = as defined in 4.2.3 of this appendix

$T_{OA}$  = as defined in 4.3.4 of this appendix

$X_2$  = as defined in 4.1.15 of this appendix

$T_{OA}$  = as defined in 4.3.4 of this appendix

#### 4.3.3 Off-cycle sensible heat loss.

For vented heaters equipped with single stage

thermostats, calculate the off-cycle sensible

heat loss ( $L_{S,OFF}$ ) at the maximum fuel input

rate. For vented heaters equipped with step-

modulating thermostats, calculate  $L_{S,OFF}$

defined as:

$$L_{S,OFF} = X_1 L_{S,OFF,red}$$

where:

$X_1$  = as defined in 4.1.14 of this appendix

$L_{S,OFF,red}$  = as defined as  $L_{S,OFF}$  in 4.3.3 of this

appendix at the reduced fuel input rate

$$L_{S,ON} = X_1 L_{S,SS,A-red} + X_2 L_{S,SS,A-max}$$

where:

$X_1$  = as defined in 4.1.14 of this appendix

$L_{S,SS,A-red}$  = as defined as  $L_{S,SS,A}$  in 4.1.9 of this

appendix at the reduced fuel input rate

$X_2$  = as defined in 4.1.15 of this appendix

$L_{S,SS,A-max}$  = as defined as  $L_{S,SS,A}$  in 4.1.9 of this

appendix at the maximum fuel input rate

For vented heaters with step-modulating

thermostats, calculate  $L_{S,ON}$  defined as:

$$L_{S,ON} = X_1 L_{S,SS,A-red} + X_2 L_{S,SS,A-avg}$$

where:

$X_1$  = as defined in 4.1.14 of this appendix

$L_{S,SS,A-red}$  = as defined in 4.3.1 of this

appendix

$X_2$  = as defined in 4.1.15 of this appendix

$L_{S,SS,A-avg}$  = average sensible heat loss for step-

modulating vented heaters operating in

the modulating mode



$$L_{S,OFF} = \frac{100(0.24)}{Q_{in,t_{on}}} \sum m_{S,OFF}(T_{S,OFF} - T_{RA})$$

where:

100=conversion factor for percent  
0.24=specific heat of air in Btu per pound - °F

$Q_{in}$ =fuel input rate, as defined in 3.1 of this appendix in Btu per minute (as appropriate for the firing rate)

$t_{on}$ =average burner on-time per cycle and is 20 minutes

$\sum m_{S,OFF}(T_{S,OFF} - T_{RA})$ =summation of the twenty values of the quantity,  $m_{S,OFF}(T_{S,OFF} - T_{RA})$ , measured in accordance with 3.3 of this appendix

$m_{S,OFF}$ =stack gas mass flow rate pounds per minute

$$m_{S,OFF} = \frac{1.325 P_B V_T (C_T - C_T)}{C_T (T_T + 460)}$$

$T_{S,OFF}$ =stack gas temperature measured in accordance with 3.3 of this appendix

$T_{RA}$ =average room temperature measured in accordance with 3.3 of this appendix

$P_B$ =barometric pressure in inches of mercury  
 $V_T$ =flow rate of the tracer gas through the stack in cubic feet per minute

$C_T$ =concentration by volume of the active tracer gas in the mixture in percent and is 100 when the tracer gas is a single component gas

$C_T$ =concentration by volume of the active tracer gas in the diluted stack gas in percent

$T_T$ =temperature of the tracer gas entering the flow meter in degrees Fahrenheit

$(T_T + 460)$ =absolute temperature of the tracer gas entering the flow meter in degrees Rankine

**4.3.4 Average outdoor temperature.** For vented heaters equipped with single stage thermostats, the average outdoor temperature ( $T_{OA}$ ) is 45 °F. For vented heaters equipped with either two stage thermostats or step-modulating thermostats,  $T_{OA}$  during the reduced operating mode is obtained from Table 3 or Figure 1 of this appendix. For vented heaters equipped with two stage thermostats,  $T_{OA}$  during the maximum operating mode is obtained from Table 3 or Figure 1 of this appendix.

**4.3.5 Off-cycle infiltration heat loss.** For vented heaters equipped with single stage thermostats, calculate the off-cycle infiltration heat loss ( $L_{I,OFF}$ ) at the maximum fuel input rate. For vented heaters equipped with step-modulating thermostats, calculate  $L_{I,OFF}$  defined as:

$$L_{I,OFF} = X_1 L_{I,OFF,red}$$

where:

$X_1$ =as defined in 4.1.14 of this appendix

$L_{I,OFF,red}$ =as defined in  $L_{I,OFF}$  in 4.3.3 of this appendix at the reduced fuel input rate

For vented heaters equipped with two stage thermostats, calculate  $L_{I,OFF}$  defined as:

$$L_{I,OFF} = X_1 L_{I,OFF,red} + X_2 L_{I,OFF,max}$$

where:

$X_1$ =as defined in 4.1.14 of this appendix

$L_{I,OFF,red}$ =as defined as  $L_{I,OFF}$  in 4.3.3 of this appendix at the reduced fuel input rate

$X_2$ =as defined in 4.1.15 of this appendix

$L_{I,OFF,max}$ =as defined as  $L_{I,OFF}$  in 4.3.3 of this appendix at the maximum fuel input rate

Calculate the off-cycle infiltration heat loss ( $L_{I,OFF}$ ) expressed as a percent and defined as:

$$L_{I,OFF} = \frac{100(0.24)(1.3)(0.7)(70 - T_{OA})}{Q_{in,t_{on}}} \sum m_{S,OFF}$$

where:

100=conversion factor for percent

0.24=specific heat of air in Btu per pound - °F

1.3=dimensionless factor for converting laboratory measured stack flow to typical field conditions

0.7=infiltration parameter

70=assumed average indoor air temperature, °F

$T_{OA}$ =average outdoor temperature as defined in 4.3.4 of this appendix

$Q_{in}$ =fuel input rate, as defined in 3.1 of this appendix in Btu per minute (as appropriate for the firing rate)

$t_{on}$ =average burner on-time per cycle and is 20 minutes

$\sum m_{S,OFF}$ =summation of the twenty values of the quantity,  $m_{S,OFF}$ , measured in accordance with 3.3 of this appendix

$m_{S,OFF}$ =as defined in 4.3.3 of this appendix

**4.3.6 Part-load fuel utilization efficiency.**

Calculate the part-load fuel utilization efficiency ( $\eta_u$ ) expressed as a percent and defined as:

$$\eta_u = 100 - L_{I,A} - C_j L_j - \left[ \frac{t_{on}}{t_{on} + P_F t_{OFF}} \right] + [L_{N,ON} + L_{B,OFF} + L_{I,ON} + L_{B,OFF}]$$

where:

$C_j$ =2.8, adjustment factor

$L_j$ =jacket loss as defined in 4.1.5

$L_{I,A}$ =as defined in 4.1.6 of this appendix

$t_{on}$ =as defined in 4.3.3 of this appendix

$L_{S,ON}$ =as defined in 4.3.1 of this appendix

$L_{S,OFF}$ =as defined in 4.3.3 of this appendix

$L_{I,ON}$ =as defined in 4.3.2 of this appendix

$L_{I,OFF}$ =as defined in 4.1.4 of this appendix

$P_F$ =as defined in 4.1.4 of this appendix

$t_{OFF}$ =average burner off-time per cycle and is 20 minutes

**4.3.7 Annual fuel utilization efficiency.**

Calculate the annual fuel utilization efficiency (AFUE) expressed as a percent and defined as:

$$AFUE = \frac{4400 \eta_{SS-WT} \eta_u Q_{in-max}}{4400 \eta_{SS} Q_{in-max} + 2.5(4600) \eta_u Q_p}$$

where:

4400=as defined in 4.2.6

$\eta_{SS-WT}$ =as defined in 4.1.16 of this appendix

$\eta_u$ =as defined in 4.3.6 of this appendix

$Q_{in-max}$ =as defined in 4.2.6 of this appendix

4600=as defined in 4.2.6 of this appendix

$Q_p$ =as defined in 3.5 of this appendix

**4.4 Stack damper effectiveness for vented heaters equipped with electro-mechanical**

**stack dampers.** Determine the stack damper effectiveness for vented heaters equipped with electro-mechanical stack dampers ( $D_o$ ), defined as:

$$D_o = 1.62 [1 - A_D \cos \Omega / A_S]$$

where:

$A_D$ =as defined in 3.4 of this appendix

$\Omega$ =as defined in 3.4 of this appendix

$A_S$ =as defined in 3.4 of this appendix

**4.5 Addition requirements for vented home heating equipment using indoor air for combustion and draft control.** For vented home heating equipment using indoor air for combustion and draft control,  $D_F$ , as described in section 4.1.2 of this appendix, and  $D_S$ , as described in section 4.1.3 of this appendix, shall be determined from Table 1 of this appendix.

**4.5.1 Optional procedure for determining  $D_F$  for vented home heating equipment.**

Calculate the ratio ( $D_F$ ) of the rate of flue gas mass through the vented heater during the off-period,  $M_{F,OFF}(T_{F,SS})$ , to the rate of flue gas mass flow during the on-period,  $M_{F,SS}(T_{F,SS})$ , and defined as:

$$D_F = M_{F,OFF}(T_{F,SS}) / M_{F,SS}(T_{F,SS})$$

For vented heaters in which no draft is maintained during the steady-state or cool down tests,  $M_{F,OFF}(T_{F,SS})$  is defined as:

$$M_{F,OFF}(T_{F,SS}) = M_{F,OFF}(T_{F,OFF}^*) \left[ \frac{T_{F,SS} - T_{RA}}{T_{F,OFF}^* - T_{RA}} \right]^{0.56} \left[ \frac{T_{F,OFF}^* + 460}{T_{F,SS} + 460} \right]^{1.19}$$

For oil fueled vented heaters in which an imposed draft is maintained, as described in section 3.6 of this appendix,  $M_{F,OFF}(T_{F,SS})$  is defined as:

$$M_{F,OFF}(T_{F,SS}) = M_{F,OFF}(T_{F,SS}^*)$$

where:

$T_{F,SS}$ =as defined in 3.1.1 of this appendix

$T_{F,OFF}^*$ =flue gas temperature during the off-period measured in accordance with 3.6 of this appendix in degrees Fahrenheit

$T_{RA}$ =as defined in 2.9 of this appendix



$$M_{F,OFF}(T_{F,OFF}) = \frac{1.325 P_B V_T (100 - C_T)}{C_T (T_T + 460)}$$

$P_B$  = barometric pressure measured in accordance with 3.6 of this appendix in inches of mercury

$V_T$  = flow rate of tracer gas through the vented heater measured in accordance with 3.6 of this appendix in cubic feet per minute

$C_T$  = concentration by volume of tracer gas present in the flue gas sample measured in accordance with 3.6 of this appendix in percent

$C_T^*$  = concentration by volume of the active tracer gas in the mixture in percent and is 100 when the tracer gas is a single component gas

$T_T$  = the temperature of the tracer gas entering the flow meter measured in accordance with 3.6 of this appendix in degrees Fahrenheit

$(T_T + 460)$  = absolute temperature of the tracer gas entering the flow meter in degrees Rankine

$M_{F,SS}(T_{F,SS}) = Q_{in}[R_{T,F}(A/F) + 1]/[60HHV_A]$

$Q_{in}$  = as defined in 3.1 of this appendix

$R_{T,F}$  = as defined in 4.1.7 of this appendix

$A/F$  = as defined in 4.2.2 of this appendix

$HHV_A$  = as defined in 4.2.2 of this appendix

4.5.2 *Optional procedure for determining off-cycle draft factor for flue gas flow for vented heaters.* For systems numbered 1 thru 10, calculate the off-cycle draft factor for flue gas flow ( $D_F$ ) defined as:

$$D_F = D_P$$

For systems numbered 11 or 12:  $D_F = D_P D_0$

where:

$D_P$  = as defined in 4.5.1 of this appendix

$D_0$  = as defined in 4.4 of this appendix

4.5.3 *Optional procedure for determining off-cycle draft factor for stack gas flow for vented heaters.* Calculate the off-cycle draft factor for stack gas flow ( $D_S$ ) defined as:

For systems numbered 1 or 2:  $D_S = 1.0$

For systems numbered 3 or 4:  $D_S = (D_P + 0.79)/1.4$

For systems numbered 5 or 6:  $D_S = D_0$

For systems numbered 7 or 8 and if  $D_0(S/F) < 1$ :  $D_S = D_0 D_P$

For systems numbered 7 or 8 and if  $D_0(S/F) > 1$ :

$$D_S = D_0 D_P + [0.85 - D_0 D_P] [D_0(S/F) - 1]/[S/F - 1]$$

where:

$D_P$  = as defined in 4.5.1 of this appendix

$D_0$  = as defined in 4.4 of this appendix

TABLE 1.—OFF-CYCLE DRAFT FACTORS FOR FLUE GAS FLOW ( $D_F$ ) AND FOR STACK GAS FLOW ( $D_S$ ) FOR VENTED HOME HEATING EQUIPMENT EQUIPPED WITHOUT THERMAL STACK DAMPERS

System number	( $D_F$ )	( $D_S$ )	Burner type	Venting system type <sup>1</sup>
1	1.0	1.0	Atmospheric	Draft hood or diverter.
2	0.4	1.0	Power	Draft hood or diverter.
3	1.0	1.0	Atmospheric	Barometric draft regulator.
4	0.4	0.85	Power	Barometric draft regulator.
5	1.0	$D_0$	Atmospheric	Draft hood or diverter with damper.
6	0.4	$D_0$	Power	Draft hood or diverter with damper.

TABLE 1.—OFF-CYCLE DRAFT FACTORS FOR FLUE GAS FLOW ( $D_F$ ) AND FOR STACK GAS FLOW ( $D_S$ ) FOR VENTED HOME HEATING EQUIPMENT EQUIPPED WITHOUT THERMAL STACK DAMPERS—Continued

System number	( $D_F$ )	( $D_S$ )	Burner type	Venting system type <sup>1</sup>
7	1.0	$D_0$	Atmospheric	Barometric draft regulator with damper.
8	0.4	$D_0 D_P$	Power	Barometric draft regulator with damper.
9	1.0		Atmospheric	Direct vent.
10	0.4		Power	Direct vent.
11	$D_0$		Atmospheric	Direct vent with damper.
12	0.4	$D_0$	Power	Direct vent with damper.

<sup>1</sup> Venting systems listed with dampers means electro-mechanical dampers only.

TABLE 2.—VALUES OF HIGHER HEATING VALUE ( $HHV_A$ ), STOICHIOMETRIC AIR/FUEL ( $A/F$ ), LATENT HEAT LOSS ( $L_{LA}$ ) AND FUEL-SPECIFIED PARAMETERS ( $A$ ,  $B$ ,  $C$ , AND  $D$ ) FOR TYPICAL FUELS

Fuels	HHV (Btu/lb)	A/F	$L_{LA}$	A	B	C	D
No. 1 oil	19,800	14.56	6.55	0.0679	14.22	0.0179	0.167
No. 2 oil	19,500	14.49	6.50	0.0667	14.34	0.0181	0.167
Natural gas	20,120	14.45	9.55	0.0919	10.96	0.0175	0.171
Manufactured gas	18,500	11.81	10.14	0.0965	10.10	0.0155	0.235
Propane	21,500	15.58	7.99	0.0841	12.60	0.0177	0.151
Butane	20,000	15.36	7.79	0.0808	12.93	0.0180	0.143

TABLE 3.—FRACTION OF HEATING LOAD AT REDUCED OPERATING MODE (X1) AND AT MAXIMUM OPERATING MODE (X2), AVERAGE OUTDOOR TEMPERATURES (TOA AND TOA\*), AND BALANCE POINT TEMPERATURE (TC) FOR VENTED HEATERS EQUIPPED WITH EITHER TWO-STAGE THERMOSTATS OR STEP-MODULATING THERMOSTATS

Heat output ratio *	X1	X2	TOA	TOA*	TC
0.20 to 0.24	.12	.88	57	40	53
0.25 to 0.29	.16	.84	56	39	51
0.30 to 0.34	.20	.80	54	38	49
0.35 to 0.39	.30	.70	53	36	46
0.40 to 0.44	.36	.64	52	35	44
0.45 to 0.49	.43	.57	51	34	42
0.50 to 0.54	.52	.48	50	32	39
0.55 to 0.59	.60	.40	49	30	37
0.60 to 0.64	.70	.30	48	29	34
0.65 to 0.69	.76	.24	47	27	32
0.70 to 0.74	.84	.16	46	25	29
0.75 to 0.79	.88	.12	46	22	27
0.80 to 0.84	.94	.06	45	20	23

TABLE 3.—FRACTION OF HEATING LOAD AT REDUCED OPERATING MODE (X1) AND AT MAXIMUM OPERATING MODE (X2), AVERAGE OUTDOOR TEMPERATURES (TOA AND TOA\*), AND BALANCE POINT TEMPERATURE (TC) FOR VENTED HEATERS EQUIPPED WITH EITHER TWO-STAGE THERMOSTATS OR STEP-MODULATING THERMOSTATS—Continued

Heat output ratio *	X1	X2	TOA	TOA*	TC
0.85 to 0.89	.96	.04	45	18	21
0.90 to 0.94	.98	.02	44	16	19
0.95 to 0.99	.99	.01	44	13	17

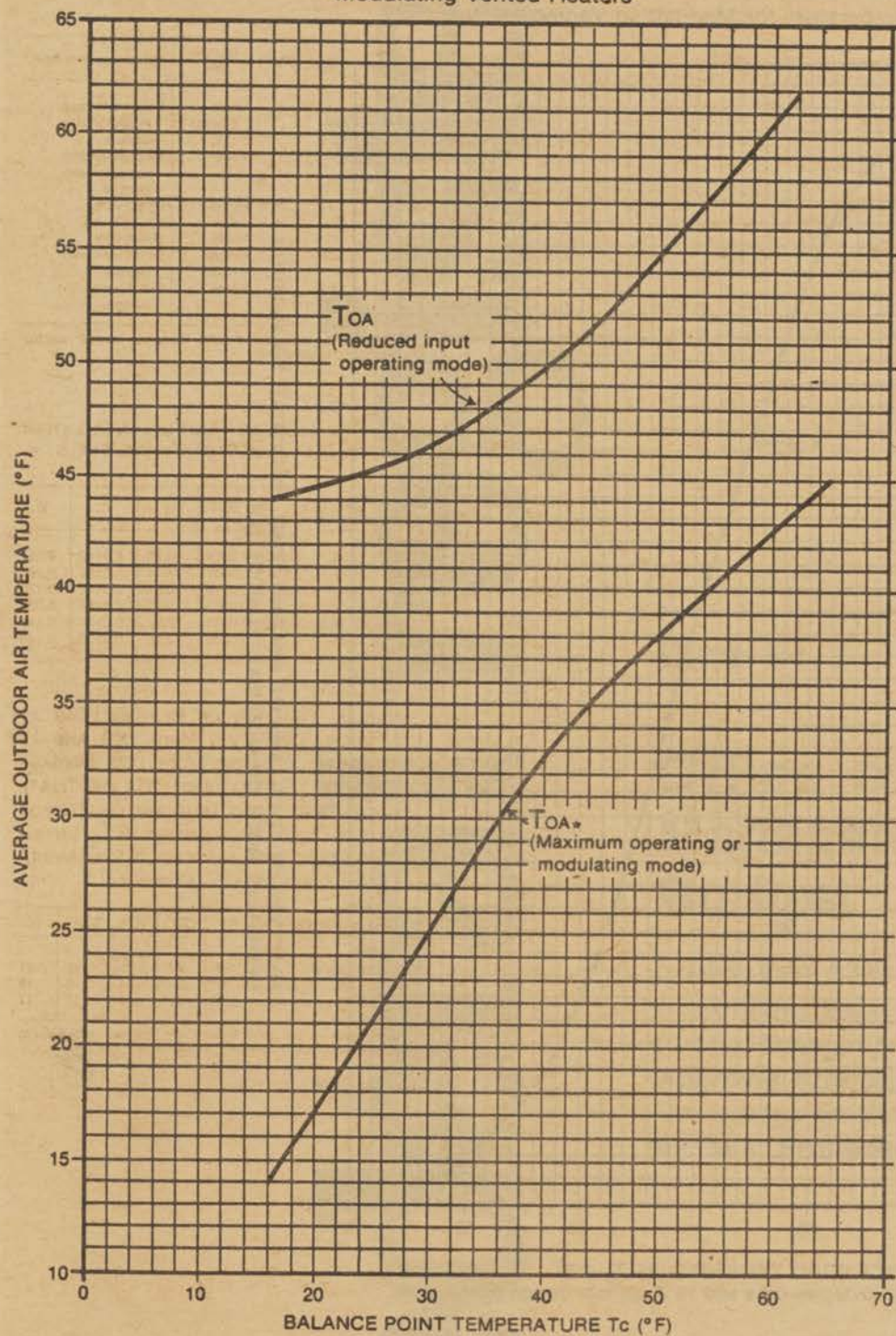
\* The heat output ratio means the ratio of minimum to maximum heat output rates as defined in 4.1.13.

BILLING CODE 6450-01-M



**FIGURE 1**

Average Outdoor Air Temperature vs. Balance Point Temperature for  
Modulating Vented Heaters

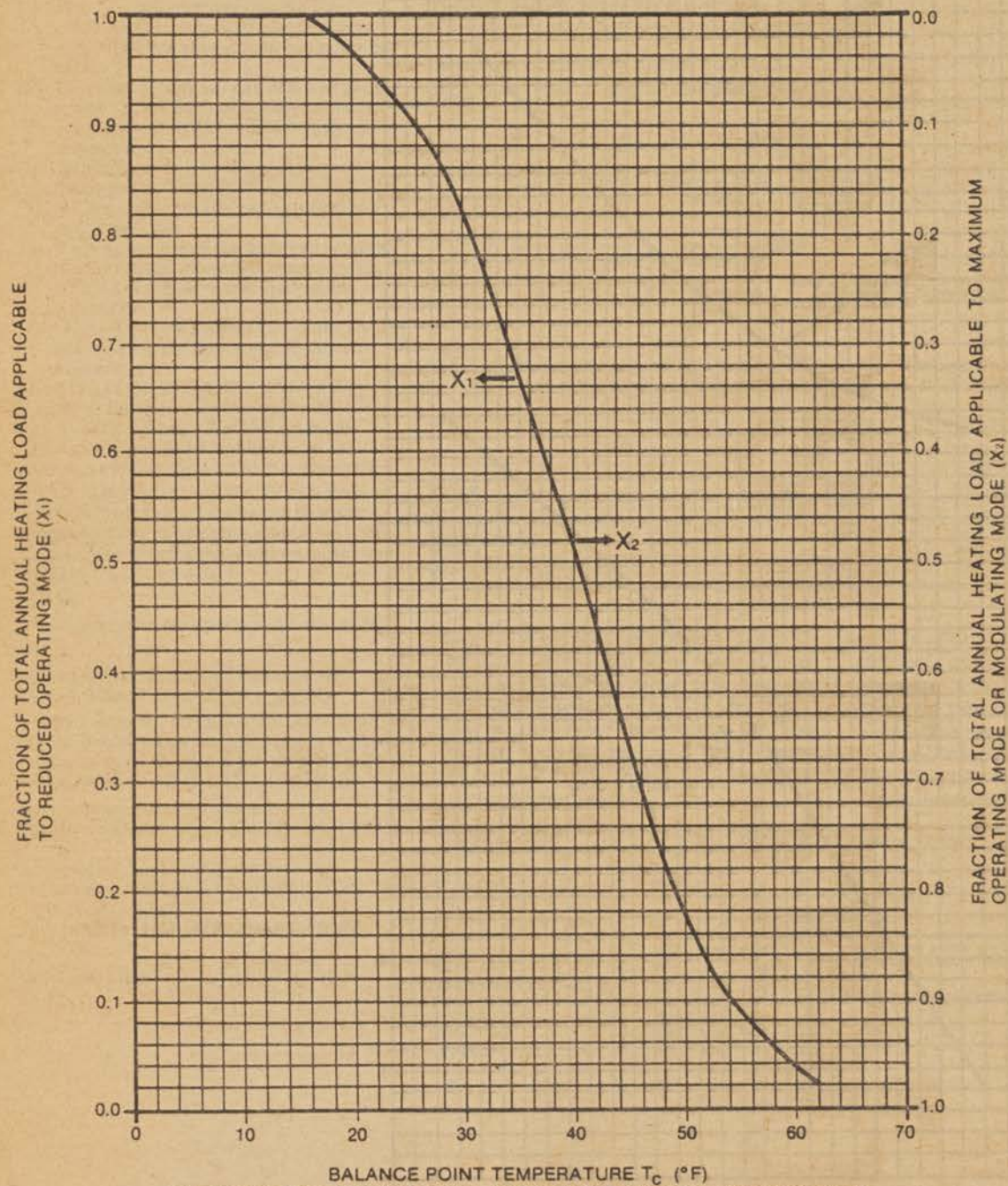


This figure is based on 4500 degree-days and 15°F outdoor design temperature.



**FIGURE 2**

Fraction of Total Annual Heating Load Applicable to Reduced Operating Mode ( $X_1$ ) and to Maximum Operating Mode or Modulating Mode ( $X_2$ ) vs. Balance Point Temperature for Modulating Vented Heaters



This figure is based on 4500 degree-days and 15°F outdoor design temperature.



# **federal register**

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**Wednesday  
March 28, 1984**

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## **Part VI**

### **Office of Management and Budget**

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#### **5 CFR Part 1320**

**Controlling Paperwork Burdens on the  
Public, Delegation of Review and  
Approval Authority to the Board of  
Governors of the Federal Reserve  
System; Proposed Rulemaking**



# OFFICE OF MANAGEMENT AND BUDGET

## 5 CFR Part 1320

### Controlling Paperwork Burdens on the Public, Delegation of Review and Approval Authority to the Board of Governors of the Federal Reserve System; Notice of Proposed Rulemaking

**AGENCY:** Office of Management and Budget, Executive Office of the President.

**ACTION:** Notice of proposed rulemaking.

**SUMMARY:** This regulation would delegate to the Board of Governors of the Federal Reserve System the authority, under the Paperwork Reduction Act of 1980 and 5 CFR 1320.9, to approve of and assign OMB control numbers to collection of information requests and requirements conducted or sponsored by the Federal Reserve Board (Board). This delegation is proposed to cover all collections of information by the Board except those meeting certain criteria specified in Appendix A and discussed in the Supplementary Information section which follows. In exercising this delegated authority, the Board is to afford the public opportunity to participate in the review process, where this is possible and appropriate, assure that the requirements of 5 CFR 1320.4(b) are adhered to, and assure that the guidelines in 5 CFR 1320.6 are considered in the review process. Board-approved collections of information will be incorporated into the official OMB inventory of currently approved collections of information. A copy of the SF83 and supporting statement and the approved collection of information instrument(s) will be placed into OMB's public docket files. Under the Act, OMB may limit, condition, or rescind this delegation at any time, but it is intended that OMB will exercise this authority only rarely and in unusual circumstances.

The Office of Management and Budget is seeking comments on this proposal to add a new paragraph (d) to 5 CFR 1320.9 and a new Appendix A to 5 CFR 1320.

**DATE:** Comments must be received on or before April 27, 1984.

**ADDRESS:** Please address all written comment to Mr. Arnold Strasser, Assistant Chief, Reports Management Branch, Office of Information and Regulatory Affairs, OMB, Washington, D.C. 20503.

**FOR FURTHER INFORMATION CONTACT:** Mr. Arnold Strasser, Assistant Chief, Reports Management Branch, Office of Information and Regulatory Affairs,

OMB, Washington, D.C. 20503 ((202) 395-6880).

**SUPPLEMENTARY INFORMATION:** Section 3507(e) of the Paperwork Reduction Act of 1980 (Act) and 5 CFR 1320.9 provide that OMB may delegate its authority to approve collections of information to an agency's designated senior official for Paperwork Reduction or to the agency head if certain conditions are met. The Act and OMB's implementing regulations require OMB to comply with the notice and comment procedures of Title 5 U.S.C. Chapter 5 before providing delegation to any agency. OMB has determined that the Board of Governors of the Federal Reserve System (Board) meets all of the requirements for delegation. Accordingly, and because OMB believes that the public has a vital interest in the administration of the Act, OMB is seeking public comment on this proposal.

The delegation would be to the Board itself because as head of the agency, the Board retains final authority to approve the agency's collections of information, subject to OMB's Paperwork Reduction Act review and approval. This authority is usually exercised by the Board as a collegial body during scheduled meetings conducted "on the record" after the public has received notification of the meeting. The agency review process for proposed collections of information considers the purpose, need, burden, and utility of each collection, and determines whether the information needed is already available to the Board. This review process culminates with Board authorization of the collection either as proposed or with Board-ordered modifications (after which Board staff transmits the proposed collections to OMB for review and approval), an order for the Board staff to reexamine and modify the proposal, or a determination that the collection of information should not be conducted because it is not necessary for the proper performance of the agency function.

Under this review procedure, instituted by the Board in 1975, collections of information proposed to be started, revised, continued without modification, or deleted are subjected to a comprehensive and rigorous evaluation by several Federal Reserve groups. Each group is charged with, among other things, the responsibility of minimizing reporting burdens while focusing special attention on smaller institutions, questioning the need for the information, and evaluating the trade-off between data needs and reporting burdens. Each reviewing group separately analyzes the proposals and

considers the need for the information, including the need for individual report items, the reporting frequency, and selection of the reporting panel. The reviews cover statutory or regulatory authority, issues of confidentiality, availability of related information, clarity of format and instructions, reporting deadlines, costs and burdens, relative burden of alternative approaches, and other relevant items. The next to the last stage of this system of critique and evaluation is conducted by three Board members including the Governor who is the Board's designated senior official for paperwork reduction activities. At each stage, the initiators may modify the proposal as a result of the review and an evaluation of the proposal at that stage accompanies the proposal to the next stage. The final, and decision, stage of the process, as noted above, is action by the Board of Governors.

The exact procedures and the particular structure of the reviewing groups may vary depending upon the nature of the collection, its relationship to statutory or regulatory requirements, and whether or not the collection is mandated by other agencies (e.g., the Federal Financial Institutions Examination Council (FFIEC)). For the bulk of proposals that entail reporting to the Board, the current process is initiated by the submission of a proposal by the Division with subject-matter responsibility for the new, revised, or extended reporting. The initiating Division prepares the proposal and reviews it for conformance with the review standards. After preliminary screening by the Financial Reports Section, the proposal is reviewed in-depth by the Steering Committee for Report Review, which is made up of staff members from both the Board and the Reserve Banks, and then is reviewed by the Presidents of the Federal Reserve Banks before being submitted to the Board members.

The whole process is under the general direction of the Board member designated as the Board's senior official for Paperwork Reduction and under the day-to-day supervision and management of a senior staff member—an Assistant to the Board who is outside the structure of the program offices that would originate proposals for information collections. The Financial Reports Section maintains staff-level administrative control throughout the review process regardless of how or where the collection proposal originates. Each Division with program responsibilities has staff designated to act as liaison with the review structure



described above and to monitor that Division's adherence to the paperwork clearance standards and procedures.

OMB believes that this review and approval process meets all the requirements for full delegation of OMB's Paperwork Reduction Act approval authority. These requirements and the reasons why OMB believes that the Board fully meets them follow.

(1) The agency review process must exhibit independence from program responsibility.

The Board of Governors, which as a collegial body is the head of the agency, makes the final decisions as to whether to conduct or sponsor a collection of information. These decisions are based on independent Board review following the intensive review within the Federal Reserve. Since the final decisions are made at head-of-agency level, the process satisfies the required independence from program responsibility.

(2) The agency must have sufficient resources to carry out responsibilities.

The Board has demonstrated a commitment to information collection reviews that, as described above, includes the use of extensive resources and personnel from all areas within the Federal Reserve.

(3) The agency review process must evaluate fairly whether the proposed collections of information should be approved.

OMB is convinced that a fair evaluation is afforded each proposal throughout each stage of the Board review process. This is evident by the fact that OMB has only refused approval to the Board twice since the Paperwork Reduction Act was implemented. Both refusals were on grounds of timing, not substance, and in each case the disapproved request was mandated by the FFIEC. (All such mandated requirements would be excluded from the area of delegated authority.)

(4) Evidence of successful performance.

All the other points previously mentioned indicate the successful performance of the Board's review process. Additionally, the Board has achieved a 25% reporting burden reduction over the FY 1981 to FY 1983 period. The Board has achieved this reduction on its own initiatives, each year requesting an information collection budget (ICB) with substantial reductions, and its requested budget has always been approved. Under the proposed delegation, the Board would continue to be subject to the ICB process, would have a budget ceiling approved, and would be required to request a higher ceiling from OMB prior

to approving an information collection that would otherwise result in the existing ceiling being exceeded by fiscal year-end.

Based on these facts, OMB proposes to give the Board of Governors of the Federal Reserve System a delegation to approve its collections of information subject to the following three exceptions.

The first exception would apply when the proposed collections or proposed revisions to existing collections are required by the FFIEC or other Federal executive branch entity with authority to require the Board to conduct or sponsor a collection of information. In this situation, the Board's review authority would not satisfy the criterion for an independent evaluation as to whether the proposed collection or change should be approved. Since the decision to require the information collection came from outside the Board and was imposed on the Board, the Board would not be an independent party in the review.

The second exception where review would revert to OMB is if the Board proposed to delete or change information it currently collects that is required and used by another agency, and, after the staff of the Board and the other agency have attempted to resolve the problem, the head of that agency objects is writing to OMB before the end of the comment period specified by the Board.

The third exception would be in the case of a new collection or change to an existing collection that would cause the Board to exceed its ICB ceiling by fiscal year-end.

The Board may also, at its option, request OMB to conduct any delegated review.

The Board's final action would normally be taken after the public was given reasonable opportunity to comment on the collection of information through notice in the *Federal Register*. These *Federal Register* notices will advise the public that a copy of comments may also be submitted to the OMB/OIRA desk officer for the Board. When the Board submits the notice to the *Federal Register*, a copy must also be sent to the OMB/ORRA desk officer.

However, in a situation where the Board determines that a new collection or proposed change must be instituted so quickly that public participation is not feasible and that immediate action is necessary for the Board to carry out its statutory authority or that any delay would defeat the purpose of the collection, the Board may grant an "immediate" clearance to the collection,

that is, without providing opportunity for public comment. However, upon issuing that clearance, the Board must publish in the *Federal Register* a notice informing the public of its approval and indicating why immediate action was necessary. Prior to any extension of such an approval, the Board will take into account any comments received after the institution of the collection.

The Board must also assure that all approved collections of information are reviewed at least once every three years and when any changes in the collections are proposed. This review would normally be conducted before the expiration date of the prior approval. Where the review has not been completed prior to the expiration date, the Board may extend the report, up to three months, without public notice in order to complete the review and consequent revisions, if any. There may also be other circumstances in which the Board determines that a three-month extension without public notice is appropriate.

OMB and the Board recognize that there may be some collection of information requirements in existing regulations that have not yet been reviewed by OMB and assigned OMB control numbers. According to 5 CFR 1320.14, OMB must approve all collection of information requirements contained in existing regulations, though OMB may require an agency to initiate subsequent rulemaking to modify or eliminate a requirement. Inasmuch as the proposed delegation to the Board would extend to newly instituted collection-of-information requirements, OMB believes that the Board should also have delegated authority to approve like requirements contained in existing regulations. Accordingly, the OMB proposed delegation would also permit the Board to exercise delegated authority over all collections of information in existing regulations that do not have current OMB control numbers without any suspension of their effectiveness. Upon issuance of a final OMB rule providing the proposed delegation to the Board, the Board will promptly review all such requirements, assign OMB control numbers to them, and display such numbers as required by 5 CFR 1320.14.

In determining whether to approve a collection of information under the delegation, the Board is to comply with the review criteria specified in 5 CFR 1320.4. In doing so, the Board must assure itself: (1) That the collection of information is the least burdensome necessary for the proper performance of the Board's functions and to comply



with legal requirements and achieve program objectives; (2) that the collection of information does not duplicate information otherwise accessible to the Board; and (3) that the collection of information has practical utility and that the Board has sought to minimize the cost to itself but not by means of shifting disproportionate costs or burdens onto the public.

The Board must also consider all relevant concerns, including but not limited to, comments received from the public and other government agencies, and whether or not the collection satisfies the guidelines set forth in 5 CFR 1320.6. If the collection is determined by the Board to be inconsistent with those guidelines, the Board must either disapprove the collection, change the proposal so that it conforms to the guidelines, or, upon determining that it is essential to the proper performance of the Board's function to conduct the collection as proposed, approve it.

The Board will also assure that each approved information collection displays an OMB control number, which it will assign from the block of numbers provided in advance by OMB, and the expiration date (unless the collection is contained in a regulation).

As soon as practical after approval, the Board will provide to OMB each approved collection of information, together with a completed SF83, a supporting statement, a copy of each comment received or a summary of these comments and a certification that the Board has approved the collection of information. This package will be incorporated into OMB's public docket files.

OMB may choose to review the Board's paperwork review process under the delegation at any time. The Board will cooperate in carrying out such a review. The Board will respond to any recommendations resulting from such review and, if it finds the recommendations to be appropriate, will either accept the recommendations or propose an alternative approach to achieve the intended purpose.

As required by 5 CFR 1320.9(c), the delegation may be limited, conditioned, or rescinded in whole or in part at any time. However, OMB will exercise its right to review individual information collection proposals only in unusual circumstances and, in those rare instances, will do so, subject to the provisions of 5 CFR 1320.11(f), prior to the expiration of the time period set for public comment in the Board's *Federal Register* notices. OMB will generally exercise this authority in only three situations:

(a) If prior to the commencement of a Board review (e.g., during the ICB review), it has notified the Board that it intends to review a specific new proposal for the collection of information or the continued use (with or without modification) of an existing collection;

(b) If there is substantial public objection to a proposed information collection;

(c) If OMB determines that a substantially inadequate and inappropriate lead time has been provided between the final announcement date of the proposed requirement and the first date when the information is to be submitted or disclosed.

Where OMB conducts a review of a Board information collection proposal, either because the collection is exempt from the delegation or because OMB has exercised its right to rescind the delegation with respect to that collection, or the Board has asked OMB to review the collection, the provisions of 5 CFR 1320.17 and 5 CFR 1320.19 shall continue to apply.

#### Regulatory Impact and Regulatory Flexibility Act Analysis

OMB has determined that this regulation is not a major rule as defined by Executive Order 12291 and that the regulation would not have a significant economic impact on a substantial number of small businesses or other small entities.

Issued in Washington, D.C., March 22, 1984.  
Christopher C. DeMuth,  
Administrator, Office of Information and  
Regulatory Affairs.

#### List of Subjects in 5 CFR Part 1320

Reporting and recordkeeping requirements, Paperwork, Collection of information, Delegated review authority.

#### PART 1320—[AMENDED]

For the reasons set forth in the preamble, OMB proposes to amend 5 CFR Part 1320 by adding a new paragraph, (d) to § 1320.9 and by adding a new Appendix A to Part 1320 which read as follows:

#### § 1320.9 Delegation of approval authority.

(d) Subject to the provisions of this part, and in accord with the terms and conditions of each delegation as specified in Appendix A to this part, the Director delegates review and approval authority to the following agencies:

(1) Board of Governors of the Federal Reserve System

\* \* \* \* \*

#### Appendix A. Agencies With Delegated Review and Approval Authority

1. The Board of Governors of the Federal Reserve System.

(a) Authority to review and approve collection of information requests, collection of information requirements, and collections of information in current rules is delegated to the Board of Governors of the Federal Reserve System (Board).

(1) This delegation does not include review and approval authority over any new collection of information or any modification to an existing collection of information that:

(i) Is proposed to be collected as a result of a requirement or other mandate of the Federal Financial Institutions Examination Council, or other Federal executive branch entities with authority to require the Board to conduct or sponsor a collection of information.

(ii) Is objected to by another Federal agency on the grounds that that agency requires information currently collected by the Board, that the currently collected information is being deleted from the collection, and the deletion will have a serious adverse impact on the agency's program provided that such objection is certified to OMB by the head of the Federal agency involved, with a copy to the Board, before the end of the comment period specified by the Board in the *Federal Register* notices specified in (3) (i) below.

(iii) Would cause the burden of the information collections conducted or sponsored by the Board to exceed by the end of the fiscal year the Information Collection Budget allowance provided to the Board by OMB for the fiscal year-end.

(2) The Board may ask that OMB review and approve collections of information covered by this delegation.

(3) In exercising delegated authority, the Board will: (i) Provide the public, to the extent possible and appropriate, with reasonable opportunity to comment on collections of information under review prior to taking final action approving the collection. Reasonable opportunity for public comment will include publishing a notice in the *Federal Register* informing the public of the proposed collection of information, notifying the public of the availability of copies of the "clearance package," and providing the public with the opportunity to comment. Such *Federal Register* notices shall also advise the public that they may also send a copy of their comments to the OMB/OIRA Desk Officer for the Federal Reserve Board.

(A) Should the Board determine that a new collection of information or a change in an existing collection must be instituted quickly and that public participation in the approval process would defeat the purpose of the collection or substantially interfere with the Board's ability to perform its statutory obligation, the Board may approve of the collection of information without providing opportunity for public comment. At the earliest practical date after approving the collection of information, the Board will publish a *Federal Register* notice informing the public of its approval of the collection of



information and indicating why immediate action was necessary.

(B) In such cases, before taking final action to reauthorize the collection of information for an additional period, the Board will take into account any comments received after the institution of the collection.

(ii) Provide the OMB desk officer for the Federal Reserve Board with a copy of the Board's Federal Register notice not later than the day the Board files the notice with the Office of the Federal Register.

(iii) Assure that approved collections of information are reviewed not less frequently than once every three years, and that such reviews are normally conducted before the expiration date of the prior approval. Where the review has not been completed prior to the expiration date, the Board may extend the report, for up to three months, without public notice in order to complete the review and consequent revisions, if any. There may also be other circumstances in which the Board determines that a three-month extension without public notice is appropriate.

(iv) Take every reasonable step to ensure that the collection of information conforms to the requirements of 5 CFR 1320.4(b). In determining whether to approve a collection of information, the Board will consider all comments received from the public and other agencies. The Board will not approve a collection of information that it determines does not satisfy the guidelines set forth in 5 CFR 1320.6, unless it determines that departure from these guidelines is necessary to satisfy statutory requirements or other substantial need.

(v) Assure that each approved collection of information displays an OMB control number and that all collections of information, except

those contained in regulations, display the expiration date of the approval.

(vi) Assure that each approved collection of information, together with a completed SF83, a supporting statement, a copy of each comment received from the public and other agencies in response to the Board's Federal Register notice or a summary of these comments, and a certification that the Board has approved of the collection of information in accordance with the provisions of this delegation is transmitted to OMB for incorporation into OMB's public docket files. Such transmittal shall be made as soon as practical after the Board has taken final action approving the collection. However, no collection of information may be instituted until the Board received written or oral notification from OMB or OMB staff that the transmittal has been received.

(b) OMB will:

(1) Provide the Board in advance with a block of control numbers which the Board will assign in sequential order to, and display on, new collections of information.

(2) Provide a written notice of action to the Board indicating the Board approvals of collections of information have been received by OMB and incorporated into OMB's public docket files and inventory of currently approved collections of information.

(3) Review any collection of information referred by the Board in accordance with the provisions of section 1(a)(2) of the appendix.

(c) OMB may review the Board's paperwork review process under the delegation. The Board will cooperate in carrying out such a review. The Board will respond to any recommendations resulting from such review and, if it finds the recommendations to be appropriate, will either accept the recommendations or

propose an alternative approach to achieve the intended purpose.

(d) This delegation may, as provided by 5 CFR 1320.9(c), be limited, conditioned, or rescinded, in whole or in part at any time. OMB will exercise this authority only in unusual circumstances and, in those rare instances, will do so subject to the provisions of 5 CFR 1320.11(f), prior to the expiration of the time period set for public comment in the Board's Federal Register notice and generally only if:

(1) Prior to the commencement of a Board review (e.g., during the ICB review), OMB has notified the Board that it intends to review a specific new proposal for the collection of information or the continued use (with or without modification) of an existing collection;

(2) There is substantial public objection to a proposed information collection; or

(3) OMB determines that a substantially inadequate and inappropriate lead time has been provided between the final announcement date of the proposed requirement and the first date when the information is to be submitted or disclosed.

When OMB exercises this authority it will consider that the period of its review began the day that OMB received the Federal Register notice provided for in Section 1(a)(3)(i) of the Appendix.

(e) Where OMB conducts a review of a Board information collection proposal under Section 1(a)(1), 1(a)(2), or 1(d) of this Appendix, the provisions of 5 CFR 1320.17 and 5 CFR 1320.19 continue to apply.

(Paperwork Reduction Act of 1980, (Pub. L. 96-511); 44 U.S.C. Chapter 3)

[FR Doc. 84-8242 Filed 3-27-84; 8:45 am]

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